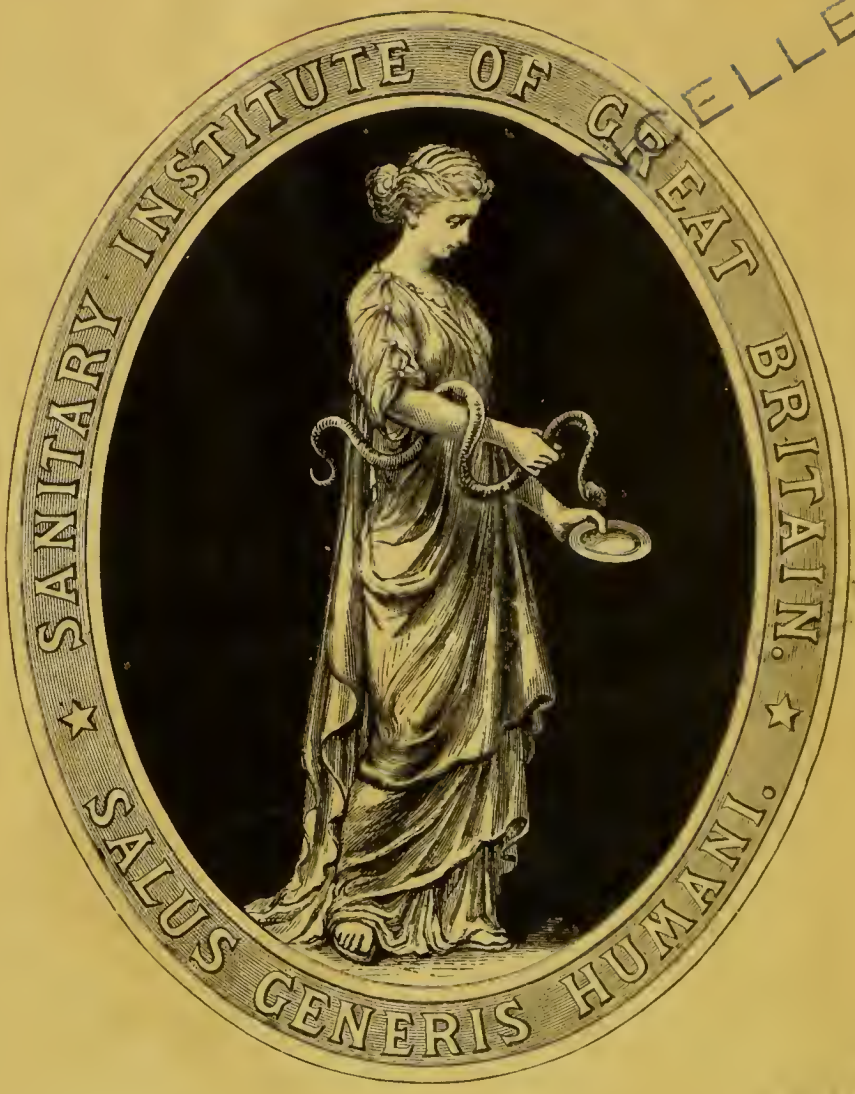
FIRE PROTECTION OF MANSIONS

JAMES COMPTON MERRYWEATHER



With the Authors
Compliments

FIRE PROTECTION

OF

MANSIONS.

HOW TO PREVENT FIRES AND HOW TO EXTINGUISH THEM.

WITH PRACTICAL REMARKS UPON WATER SUPPLY AND FIRE APPARATUS.

BY

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PREFACE.

This little book is intended for the owners and occupiers of large country seats, and for their principal servants entrusted with the management of the mansions or estates. Its objects are to remind the owners of the special dangers from fire to which many residential mansions are exposed, the inevitable dangers to which all are necessarily exposed, and the consequent need and value of proper fire protective arrangements; and to inform their estate agents and stewards as to the means by which these arrangements for preventing and extinguishing fires may be made and maintained, the best methods of guarding day by day against an outbreak, and of coping with it should one occur.

Without any great presumption I may claim to speak upon this subject with some warrant and

authority. I have had nearly thirty years' experience in designing and carrying out fire protective works in buildings of this class, in forming public and household fire brigades, and in constructing fire extinguishing machinery, with the manufacture of which in England the name of my firm (Messrs. Merryweather and Sons, of Long Acre), with that of one other house, has become almost exclusively identified.

Although I have not been able altogether to avoid them, my remarks have been, as far as possible, kept free from the technicalities of the fireman's profession, and I do not think much will be found in the following pages the meaning of which a gentleman after half an hour's practical acquaintance with his fire apparatus would fail to understand. One or two of the chapters, particularly those upon fire apparatus and water supply, are intended to furnish practical information which will enable those who have to decide upon questions relating to fire and water machinery to select that best adapted to the special requirements of the house. I have therefore been compelled here to deal with matters of detail, but I have not done so with

the fulness and scientific accuracy which would be necessary if I were writing for engineers; I have endeavoured to roughly sketch a tolerably complete outline which must, in each particular instance, be developed and filled in by the engineer who is entrusted with the execution of the necessary works. The book has a practical purpose, and has been somewhat hurriedly written in the intervals of my usual business avocations; I have not, therefore, endeavoured after literary graces, nor given much attention to fine writing. The subject has been divided into as many short chapters as possible for convenient and ready reference.

JAMES COMPTON MERRYWEATHER.

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FIRE PROTECTION OF MANSIONS.

CHAPTER I.

INTRODUCTORY.

COUNTRY MANSIONS BADLY PROTECTED FROM FIRE — TOWN RESIDENCES SAFER THAN COUNTRY SEATS — MANSIONS DESTROYED DURING THE PRESENT CENTURY—NOT A QUESTION OF MONEY VALUE ALONE — INSURANCE NO "PANACEA"—DIVISION OF THE SUBJECT, FIRE PREVENTION AND EXTINCTION.

Country mansions badly protected from fire.

It is well known to those whose profession or business is concerned with the safety of country residential mansions, that as a class these buildings are not well protected against destruction by fire. Most of them have been erected with little or no regard to safety in this respect; many are situated at a distance from a supply of water copious enough for fire purposes, and from any skilled assistance available when a fire breaks out, at the same time being quite without provision for dealing with it by means of apparatus on the spot. Mansions in the Metropolis are much safer. Although London is so large, so densely crowded, and is protected by a fire department deficient both in men and machinery for the work it has to do, not the fiftieth part of the risk to a country seat attaches itself to the palatial town residence. About twelve large country houses are consumed by fire annually. The present

Town residences safer than country seats.

Mansions destroyed during the present century.

century has witnessed the partial or total demolition of many stately ancestral homes; amongst the most notable Belvoir Castle, Wynnstay, Warwick Castle, Hatfield House, Fryston Hall, Duncombe Park, Ingestre Hall, Blenheim Palace, Clumber Park, Morton Hall, Wrotham Park, Shern Hall, Lanhydroc House, and Cortachy Castle occur at once to the mind; but the number of the whole is legion, and represents a destruction of wealth which I will not attempt to estimate, but which there is no doubt whatever must be counted by millions.

Not a question of money value alone.

If it were a question of money value alone, there might be little reason for calling special attention to the safety of this class of building. Such, however, is very far from being the case. English country houses contain treasures of art and vertu absolutely priceless, because they are irreplaceable. What can be considered to be the money value of the "Nativity" which perished when Belvoir Castle was burned? or of the statuary and pictures which were destroyed with Duncombe Hall?

It is stated by Dr. Waagen, in his "Treasures of Art in Great Britain," that if all the Continental works of the most famous sculptors and painters were lost, enough of their handiwork exists in these islands to perpetuate the memory of all of them. But the rapid destruction which has during the past few years overtaken so much which was esteemed precious not only in England, but on the Continent and in America, is sufficient to awaken general apprehension.

The owners for life of the many noble mansions and their contents should not forget that they hold them in trust not only for their immediate successors, but for their fellow countrymen of the present and of succeeding generations. Such fabrics as Dunrobin, Chatsworth, Holkham, Longleat, Hatfield, Wilton, Alton Towers, Castle Howard, Temple Newsome, Arundel Castle, Hardwicke, Lathom, Knowsley, Alnwick, Burghley, Cothele, and many others deservedly create a feeling of national pride; they are

objects of interest to Englishmen in all parts of the globe, and the destruction of any of them cannot occur without being the occasion of widespread and poignant regret. The nation is also interested from the fact that the muniment rooms of many seats belonging to old and noble families are full of records capable of elucidating dark and unexplored passages of English history. It is known that the archives and documents of Alnwick Castle have furnished work for more than five years to the historian of the House of Percy. With what feelings of regret must the owner of such priceless family wealth contemplate its conversion in the course of a few hours into carbon and other gases, through the carelessness of a maidservant, or a defect in a scullery flue?

Insurance no *panacea.*

For these reasons the chief consideration which operates in many cases where buildings are left unprotected from fire does not apply to ancestral country seats. The Insurance Office is the refuge of many who have valuable property subject to the risk of fire. Owners of family heirlooms are not able to rid themselves of responsibility in this way, and they are under the necessity of doing the best to prevent the loss of what they hold in trust, as well as to indemnify themselves pecuniarily for it should the loss, in spite of all their precautions, occur. The subject of the fire protection of country seats is one, therefore, worthy of attention apart from the considerations which apply to that of other property: they are the unsafest, though one of the most valuable, of all the "risks" in the country.

Fire protection and extinction.

Protection from fire obviously divides itself into two parts —prevention and extinction. The former concerns itself with the causes and origin of fires, and with the manner of avoiding them; that is to say, with the remedy of structural defects which create danger, and with the regulations which should be framed to enforce care on the part of servants and inmates. The latter has to do with the drill and training of servants in the best methods of acting in emergencies, and the provision

of suitable appliances for their use; and especially with the securing of a sufficiently copious supply of water, usually the most important, expensive, and difficult part of the fire arrangements. In writing upon the subject I shall observe this division; dealing first with the most common causes of fires, and with the best means of minimising the danger arising out of them.

CHAPTER II.

COMMON CAUSES OF FIRE.

MOST FIRES PREVENTIBLE—STRUCTURAL DEFECTS—CARELESSNESS—OCCASIONAL CAUSES—HOW TO PREVENT FIRES—NIGHTLY INSPECTION BY A RESPONSIBLE SERVANT—REGULATIONS RESPECTING LIGHTS — GAS — ELECTRIC LIGHTING—KITCHEN BOILERS—KITCHENERS—FIRE STOVES—HOT AIR AND WATER PIPES—SMOKING, ETC., IN BED—SPONTANEOUS COMBUSTION—LETTER FROM MR. SUPERINTENDENT TOZER UPON CAUSES OF FIRES IN MANSIONS.

Most fires preventible.

THE way in which fires commonly originate is worthy of some consideration; especially as most arise from causes which are easily preventible. Buildings of all kinds are liable to special risks which appertain to the class they belong to, and also to risks which are common to all buildings. The following are the most active causes of the destruction of residential mansions :—

Structural defects.

Structural Defects; such as defective flues, timber in flues, hearths laid upon timber, &c. In most large houses there are, unfortunately, many such hidden and unsuspected sources of danger. Their presence can only be ascertained by a careful and intelligent search for them. Many fine palaces have been laid in ruins in consequence of a little inattention to some structural vice or deficiency. One recent instance out of many is that of Ingestre Hall; the Earl of Shrewsbury and Talbot, writing to the *World* upon the subject, says, "There can be no doubt that this most disastrous affair occurred through a beam having been placed, when the house was originally built, directly under and too near the hearthstone; and the wonder must be to all who either saw the fire

or who have since seen the ruins, that the old place had never met this sad fate before." Timber left exposed in the construction of roofs has been a frequent cause of fire, and there are many similar dangers, not very patent to the casual observer, but which it is the business of the fire engineer to find out and rectify.

Carelessness.

Carelessness of Servants and Inmates, with lucifers, lamps, candles, and other lights. Children playing with lucifers and other inflammable things. Linen left to dry too near exposed fireplaces. Cooking utensils put away too hot, or fire adhering to them. Smoking, reading, or sewing in bed, and falling asleep with lights too near bedding and curtains. Filling mineral oil and spirit lamps too near exposed fires and lights. Leaving lighted tobacco in pockets. Smoking tobacco. Putting away hot ashes before extinguishing them. Leaving wax tapers (especially green tapers) smouldering. Putting away hot coke near timber. Carelessness in sweeping flues and in raking out fires at night. Carelessness of workpeople with temporary fires, especially upon roofs.

Occasional causes.

The above are the most frequent causes of fires in residential mansions ; the following may also possibly occasion disaster :— Sparks from fires. Curtains and other pendant things left too near fires and lights. Domestic animals overturning lamps and other lights. Swinging gas jets. Gas brackets badly fixed. Explosions of mineral oil lamps. Birds' nests exposed under eaves and in recesses on roofs. Dresses coming in contact with fires and lights. Persons seized with fits falling on to fire. Spontaneous ignition of oily rags, &c. Dissensions and fighting near fires and lights. Intoxication. Incendiarism by servants to hide robbery, &c. Monomania. Lightning. Electricity. Sun's rays concentrated in various ways.

How to prevent fires.

It is evident upon consideration of the manner in which fires most commonly originate that by far the largest proportion are caused by carelessness of one form and another. To prevent fires, it is therefore essential to combat the carelessness of individual servants and inmates ; a most

difficult task, and one which can never be perfectly performed. For this reason, arrangements for extinguishing fire are indispensable, but there is no reason why the best possible should not be done to prevent them breaking out, notwithstanding that complete success cannot be hoped for. To this end I recommend that the butler or some other responsible servant should be commissioned to examine the premises throughout before retiring for the night, and his attention should be specially called to the common causes of fires as before enumerated, so that he may know in what manner to make his search complete. He should always take with him one of the other servants, each in turn, for the purpose of impressing upon each the necessity of vigilance at all times in guarding against fire. A simple system such as this, if properly and punctiliously carried out, would ensure a large degree of safety, and would be much more effective than many elaborate arrangements which have been made for the same purpose. The drilling of the servants in the use of fire apparatus I shall refer to later on; the servant charged with the duty I have just mentioned should be captain of the household brigade, and he should be empowered to insist upon the few regulations with respect to matches, lights, &c., which follow, being strictly carried out, and to make whatever small alterations may be necessary to perfect the gas arrangements.

Nightly inspection by a responsible servant.

Regulations respecting lights.

1.—None but safety matches which light only by friction should be allowed in any part of the building.

2.—Matches must not be thrown upon the floor after use, nor unused matches left where children can get at them.

3.—Candles must not be allowed to burn down to the socket.

4.—Temporary lights must not be obtained by means of paper.

5.—Lamps must only be refilled by daylight, and only oil of the best quality used.

6.—Gas brackets if fixed in dangerous positions must be at once removed or made secure.

7.—As far as possible all gas jets should be protected by shades, and if there are any shields they should be of metal. Gas should not be turned off at the meter at night. The main gas pipe to the meter should be fitted with a tap by means of which the whole supply can be turned off from the outside in the event of fire. This is a very valuable precaution, and one which should on no account be neglected. Gas pipes throughout should be of iron, not of lead or composition, which easily melt, and which are also liable to be damaged by rats and mice.

Gas.

Gas is on the whole the safest means of lighting. Almost the only danger which attaches itself to this method is that of an undetected escape, or of improper proceedings when an escape has been noticed, and endeavours are being made to localise it. Whenever the organ of smell has discovered an escape, windows should immediately be thrown open at top and bottom, that the immediate danger may be avoided ; the gas turned off from burners already lighted, and then the main cock at the meter should be shut. Of course no light should be brought into the place. If an examination of the burners, plugs, taps, and water cups does not result in the discovery of the source of the mischief, the gas may be turned on very slightly at the meter, and, as a last resource, the windows having previously been open for some time, a lighted taper may be run along the pipes.

Electric lighting.

Dangers arising from electric light wires, &c., must be carefully guarded against, especially when the arc light is employed. Fire is easily propagated by this method of lighting in several ways. As the simplest means of indicating the precautions which should be adopted, I subjoin the rules and regulations recommended by the Society of Telegraph Engineers and Electricians. They do not all apply to the risk from fire, but

as they are all useful I shall be readily pardoned for inserting them in their entirety.

I.—The Dynamo Machine.

1.—The dynamo machine should be fixed in a dry place.

2.—It should not be exposed to dust or flyings.

3.—It should be kept perfectly clean and its bearings well oiled.

4.—The insulation of its coils and conductors should be practically perfect.

5.—All conductors in the dynamo room should be firmly supported, well insulated, conveniently arranged for inspection, and marked or numbered.

II.—The Wires.

6.—Every switch or commutator used for turning the current on or off should be constructed so that when it is moved and left it cannot permit of a permanent arc or of heating.

7.—Every part of the circuit should be so determined that the gauge of wire to be used is properly proportioned to the currents it will have to carry, and all junctions with a smaller conductor should be fitted with a suitable safety fuse or protector, so that no portion of the conductor should ever be allowed to attain a temperature exceeding 150° F.

8.—Under ordinary circumstances complete metallic circuits should be used; the employment of gas or water pipes as conductors for the purpose of completing the circuit should not in any case be allowed.

9.—Bare wires passing over the tops of houses should never be less than seven feet clear of any part of the roof, and all wires crossing thoroughfares should invariably be high enough to allow fire escapes to pass under them.

10.—It is most essential that joints should be electrically and mechanically perfect and united by solder.

11.—The position of wires when underground should be clearly indicated, and they should be laid down so as to be easily inspected and repaired.

12.—All wires used for indoor purposes should be efficiently insulated, either by being covered throughout with some insulating medium, or, if bare, by resting on insulated supports.

13.—When these wires pass through roofs, floors, walls, or partitions, or where they cross or are liable to touch metallic masses, like iron girders or pipes, they should be thoroughly protected by suitable additional covering; and where they are liable to abrasion from any cause, or to the depredations of rats or mice, they should be efficiently encased in some hard material.

14.—Where indoor wires are put out of sight, as beneath flooring, they should be thoroughly protected from mechanical injury, and their positions should be indicated.

N.B.—The value of frequently testing the apparatus and circuits cannot be too strongly urged. The escape of electricity cannot be detected by the sense of smell, as can gas, but it can be detected by apparatus far more certain and delicate. Leakage not only means waste, but in the presence of moisture it means destruction of the conductor and its insulating covering by electric action.

III.—Lamps.

15.—Arc lamps should always be guarded by proper lanterns, to prevent danger from falling incandescent pieces of carbon, and from ascending sparks. The globes should be protected with wire-netting.

16.—The lanterns, and all parts which are to be handled, should be insulated from the circuit.

IV.—Danger to Person.

17.—Where bare wire out of doors rests on insulating supports, it should be coated with insulating material, such as india-rubber tape or tube, for at least two feet on each side of the support.

18.—To secure persons from danger inside buildings, it is essential so to arrange and protect the conductors and fittings that no one can be exposed to the shocks of alternating currents of a mean electro-motive force exceeding 100 volts, or to continuous currents of 200 volts.

19.—If the difference of potential within any house exceeds 200 volts, the house should be provided with a "switch," so arranged that the supply of electricity can be at once cut off.

Kitchen boilers.

Kitchen boilers should be invariably fitted with a safety valve, which should be periodically examined, especially in frosty weather. When the supply to them is taken from a cold water cistern, it should be ascertained that the valve is in order, and that the supply is free from impediment. Disastrous explosions of these boilers have frequently occurred.

Kitcheners.

The manner in which new "kitcheners" and hot water boilers are fixed is a frequent cause of fire; the usual because the most convenient practice is to utilise some previously existing flue. The flue may have done very well for an old-fashioned kitchen grate, but with the improved "kitchener" the fire is more confined, and the draught greater, the flames often passing up the chimney with the roar of a blacksmith's forge and reaching a considerable height; weak places are discovered not by the servants but by the fire, and disaster results. Perhaps the chimney has been casually examined before the new apparatus was fixed; there was no sign of exposed timber (because it had been lightly plastered over). But the furnace soon destroys the mortar, and leaves uncovered the end of a beam which has not previously been exposed;

this in time chars, and is preparing for ready ignition, which bye-and-bye a particle of lighted fuel effects, and then comes the conflagration. Before, therefore, one of these cooking stoves is fixed, it is advisable to carry out a thorough inspection of the flue; all timber and faulty work must be removed, and the flue rebuilt with good fire-brick and clay.

Fire stoves.

Fire stoves should be provided with a wire guard; the embers should not be raked out upon the hearth when retiring to rest, but left in the grate, which is the proper place for them. These guards are specially necessary in bedrooms. Linen placed to dry before a fire ought not to be left, but should be removed to a place of safety if the person in charge is leaving the room. Ashes should be allowed thoroughly to cool before they are put away.

Hot air and water pipes.

Hot air and hot water pipes should not be fixed in proximity to timber; if they are, the continued heat may so char the wood as to cause it readily to ignite upon the least occasion, such as a spark coming into contact with it. If hot water pipes become unduly heated through a deficiency of water in the apparatus the risk is increased, and a fire may be looked for at any moment. Hot water pipes should therefore be fixed at least six inches from any wood work, and all timber in the vicinity of the pipes should be protected by a coating of non-inflammable paint or solution, of which there are several excellent kinds obtainable.

Steam and hot water apparatus is frequently fitted up by experienced people, and so fixed as to cause little or no danger to the building; but when some small addition or alteration is required it is not thought necessary to communicate with them, but the nearest tradesman is called in to do the work. He may, unfortunately, by want of a little knowledge, or by inattention, so carry out the little alteration he has to do as to introduce a very considerable danger into the mansion, and he should not therefore be allowed to touch the pipes, except under very careful supervision.

Smoking, &c., in bed.

Smoking, reading, and sewing in bed, with movable lights

near the curtains or hangings, it is needless to remark, are dangerous practices; the former especially so, because there is an additional danger in the sparks from pipe or cigar. Fires originating from this cause are very often fatal to persons in the room in which they break out. Many fires have occurred through servants and workpeople putting their pipes into the pockets of their coats before the tobacco is extinguished. Workmen at all times need some careful watching, especially when it is necessary for them to light temporary fires; plumbers working upon the roof or within the house have frequently contrived to burn the whole structure to the ground.

Spontaneous combustion has been mentioned as one of the occasional causes of fire. A short time since Professor Abel told us there was no such thing as spontaneous combustion. But the Professor admitted there was such a thing as "combustion arising from a gradual accumulation of heat, consequent on chemical changes, and the access of air to a highly heated body." This is what most fire brigade superintendents and insurance assessors mean by spontaneous combustion, and it does constitute a very real danger, although the danger is present more in manufacturing establishments than in private residences. In the latter it has chiefly to be guarded against in the kitchen. Woollen or cotton rags, and paper, lamp black, tow, charcoal, coal, or wood ashes, and many other substances, if they have been allowed to become fouled with oil, will often ignite spontaneously. Superintendent Tozer, of Manchester, in a paper upon this subject, relates the following: "In one case a piece of rag not two feet square was kept in a kitchen table drawer to wipe spots off a fender; the fender was regularly cleaned with other rags, brickdust and oil, every morning. The rag spoken of had not been used nor the drawer opened during the day. I attended the fire; it was on a summer's evening, and there had been rain during the afternoon. The kitchen on my arrival was full of smoke; neither I nor the firemen who preceded me could discover the cause for some time. I opened the table drawer,

Spontaneous combustion.

when I found the rag a charred mass." Such fires as these are easily prevented; they occur only when ordinary care and cleanliness are absent.

Letter from Superintendent Tozer upon fires in mansions.

Mr. Tozer, who has been for 22 years Superintendent of the Manchester Fire Department, wrote to me a short time since, and I have obtained his permission to print his remarks upon the subject I have in hand. Mr. Tozer has had much experience in the extinction of fires in mansions; his brigade being charged with the protection of a large residential district round the city. He says :—

"I frequently think how great the pity is that so many of our fine historical old mansions are passing away by the instrumentality of that insidious tyrant fire. The fire demon, as the newspapers like to call it, is often introduced under the impression that he is going to administer to the comfort of the inmates in the shape of heat and light. Our forefathers did with a great deal less of both than suffices for ourselves; they were, I suppose, more warm blooded, went to bed when the sun reached the horizon, and were up again with the lark in the morning. The old-fashioned fire of wood logs, in large open fireplaces, with plenty of fuel space, kept the enemy well in the front. It had no sly corners in every storey to lurk in, and could not hide under every floor, or behind skirtings, partitions, and cupboards. Now more home comforts are considered requisite, and less outdoor exercise is taken. So the gas-fitter, plumber, and carpenter have been impressed into service, and they have buried beneath the floors and other places I have just named pipes of various kinds for gas, heated air or water, or steam; in fact the whole edifice is a spider's web of these tubes, more or less carelessly fixed; they are, as a rule, too near the timber, they have right angle bends which concentrate the heat, defective joints covered with plaster, nails driven into gas pipes, the spaces so arranged that an escape cannot be detected for a time, until the vibration of walking or dancing causes the plaster to crack or the joints to give way. Then a scientific plumber is sent for from the

village ; he seeks the escape with a naked light, and finds it rather suddenly ; or he leaves a small blue flame to work its destructive way for a time until it is strong enough to burst out furiously.

" I have known of many fires at mansions, the noble owners of which have never once considered the possibility of such events occurring ; the steward has fixed the amount of the nsurance, and that is all the attention which has been given to the matter. The best Insurance is Care, Order, and Cleanliness.

" Artificial light and heat are indispensable, and must be obtained at any risk, but the flues which convey them are nasty, unsightly things, and must therefore be hidden away. In covering them up, it is forgotten how much danger their unseen presence involves. By-and-bye, unexpectedly, and when everyone is the least prepared for it, the cry of Fire ! is heard. Into the beautiful dwelling rushes a mob of mad headed clodhoppers ; the valuable collection of centuries is torn down from the shelves, pictures cut or torn from their frames, musical instruments thrown from the windows, together with mirrors and blue china (let us hope upon the empty heads of the servants and others to remind them of their folly). Every door and window is thrown open instead of being kept closed, and the wildest excitement everywhere prevails. Then we read in the papers of the regret in the neighbourhood over the destruction of the fine old building and its priceless contents ; a sort of informal inquest is held, and the usual result communicated to the world, 'faulty construction of a flue, escape of gas, or plumber's fire.' "

CHAPTER III.

WATER SUPPLY.

AN ADEQUATE SUPPLY OF WATER A PRINCIPAL PART OF THE FIRE ARRANGEMENTS—DESCRIPTION OF FIRE APPARATUS TO BE ADOPTED DETERMINED BY QUANTITY AND SITUATION OF THE WATER—DISASTROUS RESULT OF A SMALL DEFICIENCY — GRAVITATION — RESERVOIRS—RAIN WATER STORAGE—HYDRAULIC RAMS—WATER WHEELS—NEW PUMPING WATER WHEEL—TURBINES AND PUMPS—MECHANICAL MEANS OF DRIVING PUMPS — STEAM ENGINES — HOT-AIR ENGINES — GAS ENGINES — COMPARATIVE ECONOMY OF STEAM, HOT-AIR AND GAS ENGINES—WIND POWER—HORSE POWER PUMPS—HAND POWER PUMPS—EXTERNAL STORAGE—INTERNAL STORAGE—VALUE OF A GOOD SUPPLY OF WATER—EXTERNAL SUPPLY FROM LAKES, ORNAMENTAL WATERS, OR RUNNING STREAMS.

An adequate supply of water a chief consideration

THE provision of an adequate supply of water is the chief consideration connected with fire extinguishing arrangements. It is evident that without a sufficient quantity of this but little can be done, either by means of private appliances or by public fire brigades which may be in attendance, in coping with a conflagration. The water supply usually gives more trouble and causes a greater outlay than all the machinery necessary for its utilisation. The older mansions have been built for the most part without reference to the ease with which water can be brought to them ; when they are in favourable positions for this purpose, it is almost invariably the result of accident rather than of design. New mansions are usually placed where a good supply can be obtained without

difficulty or expense. It is a matter of great convenience and economy to build in proximity to elevated ground higher than the roof of the mansions, so that a reservoir can be placed thereon; in the absence of this natural advantage, a tower which will carry a large cistern should always form a part of the structure.

Question of fire apparatus determined by quantity and situation of the water.

The quantity and situation of water supply govern the decision of almost every question relating to the description, size, and disposition of the fire extinguishing machinery. If there is merely enough within the house for domestic purposes, but an ample quantity in lakes, ornamental waters, or streams in the grounds, it then becomes a question whether the internal supply shall be altered and increased, or whether reliance shall be placed upon steam or manual fire engines working from the external sources. And this cannot be decided without reference to the size, height, and shape of the building, its age and the character of its interior, which together determine whether it lends itself with a reasonable amount of security to outside protection. Another consideration is the expense attached to the various systems that might be adopted. If on the other hand there is a good quantity of water, at a fair pressure, inside the house, the fitting up of the fire plant is easy and inexpensive, and if there is water in mains surrounding the building outside it may be possible by spending a few pounds upon hydrants and hose to furnish the very best possible protection without the provision of fire engines of any kind.

I have known cases in which water in any quantity is not present within less than half a mile from the mansion, so that it became necessary (the owner objecting to the outlay necessary for improving the supply) to have a very powerful steam fire engine and a vast quantity of hose, the size of the engine being necessarily large in order to overcome the friction in the long stretch of pipe between the water and the mansion. I recollect attending upon one occasion at a mansion where this was the case. There was an excellent steam fire engine,

Result of a small deficiency.

but I found the quantity of hose there insufficient by about a hundred feet to reach from the water to the Hall. I recommended the noble owner to make good the deficiency and to keep half of the hose at the engine house by the lake and half at the mansion, so that the brigade might commence to lay down the pipes from each end in the event of fire breaking out. Consideration of my report was postponed; in the meantime fire did break out, and exactly what might have been anticipated occurred—the place was in ruins in a few hours.

Gravitation.

The best supply of water is undoubtedly that furnished by the power of direct gravitation. In all cases where a residence is sufficiently near the mains of a water company to enable a connexion to be made it will be found best to bring the company's water to the house. The pipes, in order to make the water available for fire purposes, will have to be much larger than would suffice for merely a domestic supply. Pipes of any length, even the shortest, of a diameter less than 3 in., may be considered comparatively useless for fire extinguishing. In many instances connexions have been made of sufficient size for all ordinary purposes; but when it is desired to lay fire mains through the grounds and house, it is necessary to take up all the connecting pipes and put down others of a larger size; in some cases it is found preferable to leave the existing domestic supply pipes and lay down an independent main for fire service. As I mention elsewhere, many elaborate systems of fire apparatus have been erected, which are simply useless, because the supplying pipes are not of the proper calibre.

Reservoirs.

There are, however, very few large country mansions so fortunate as to be able to obtain a supply of water in this way. But many which are situate at low levels, with tolerably high hills in the vicinity, are able to procure a good supply by gravitation, without any very enormous outlay on the part of the owner. A reservoir being constructed on high ground as near as possible to the building, it is often possible to supply it by a stream or lake from some still higher level. The water may

be allowed to flow into the reservoir in an open stream, provided no ground intervenes between the source and the inlet of the reservoir of a lower level than the latter ; even in this case a short aqueduct may get over the difficulty. If not it will be necessary to take the water to the reservoir in an enclosed pipe, which may be laid at a little distance beneath the ground and follow the undulations of the surface, always taking care that no part is placed above the level of the intervening source or of any portion of the channel which is left exposed. Streams and springs, such as I have mentioned, are frequently found in the North and West of England, in Wales and in Scotland, where there is a large rainfall, and the rock surfaces are almost impermeable ; but in the eastern and southern districts, where the geological formation is not so favourable, these streams are much more rare. As an instance in which this arrangement has been successfully carried out, I may mention the Earl of Kenmare's new residence at Killarney. To quote the words of Mr. W. E. Rich's paper, recently read before the Society of Arts, "It is supplied from springs about one mile and three "quarters distant. They yield about 15,000 gallons per day, "and are collected in a covered reservoir holding 30,000 "gallons, and situated at an elevation of 110 feet above the "house floor ; the water is conveyed thence to the house in a "four-inch cast iron pipe, which bifurcates into fire-mains and "service-pipes for drawing water direct all over the establish-"ment."

Rain water storage.

On high ground, if water is very scarce, rain water storage will at least partially meet the requirements of the case ; in some parts of the country the rainfall may be sufficient for all purposes. An artificial gathering ground may be necessary. Mr. Rich mentions an instance of a large gathering ground at Ashton Court, near Bristol, the residence of Sir Greville Smyth ; here a half acre plot of sloping ground near the summit of a hill behind the house is covered with a floor of impervious concrete with surface gutters for conveying any water falling on it to a 40,000 gallon covered reservoir below. For every inch

of rainfall upon this area, about 8,000 or 10,000 gallons of water should be delivered into the reservoir.

Artificial means.

Should it not be possible to fill the reservoir with water from a higher level, artificial means must be employed for raising it from a lower level, or from below the surface. There are many ways in which this may be done, and to the end that the most efficient and economical means be selected, it is always advisable to obtain the advice of a competent engineer.

Hydraulic rams.

If there is a running stream at a lower level than the reservoir the hydraulic ram may be brought into service. In situations where a limited supply of water is available, and a good fall can be obtained, this is very frequently employed with good results. It is a perfectly self-acting machine, and when once started needs no attendance whatever, that is, providing the ram is a good one, and has been properly fixed, and the supply water kept well clear of floating matter and grit. Too great care cannot be taken in the fixing of a ram, and without speaking disparagingly of local mechanics, I would here remark that it is always better in the end to have it fixed by the maker, leaving it to his discretion to use the proper pipes and fittings ; or at least, if it is fixed by a local tradesman, to stipulate that the supply pipe should be obtained with the ram, otherwise there is a danger of his using lighter and cheaper pipes than are requisite for the purpose. Fall pipes especially should be made of twice the ordinary thickness. A leak in the drive pipe is a constant source of trouble and annoyance, and its position is difficult to detect, therefore a little extra outlay in the first cost is well repaid.

In many cases, where a ram might be employed with much advantage, its use is thought to be impracticable on the ground that a dam is not admissible in the stream available for working it. In such instances the difficulty may be frequently overcome by carrying the water alongside the stream in an open channel or pipe drain. The machine may be placed anywhere in the length of the channel as may be most convenient.

When it is thought possible to utilise a fall of water in any given position, the particulars as mentioned below must be taken into consideration before it can be determined whether a ram would be suitable for the proposed installation, and also to decide upon the size which should be used :—

1.—Quantity of water at command in gallons per minute.

2.—The greatest fall that can be obtained by damming up the stream or spring.

3.—Perpendicular height to which the water must be forced.

4.—Distance measured along the surface from fall to place of delivery.

5.—Approximate quantity of water required.

The working of the ram may be described as follows :—

The water is conducted to the machine by the drive pipe, and escapes at the valve at the end of the ram until it has gained sufficient velocity to close the same. The flow of water, being thus suddenly checked at this outlet, however, tends to advance by its own momentum, and a portion of it is forced through a valve into the air vessel, compressing the air contained therein. The compressed air re-acts upon the water and forces it up the rising main. At this period of re-action the valve in the air chamber closes, and the water in the drive pipe being dormant the escape valve again opens, and the action is re-commenced.

The air in the air-vessel, as in common pumps, is gradually absorbed by the water passing through it, and to keep up the supply a sniff or relieve valve is fixed, so that at each stroke of the ram a portion of air is conveyed with the water into the air-vessel.

The water from the ram is usually delivered into a tank or reservoir placed at an elevation, so that it can be led by pipes to the various places where it is wanted, and thus enable a constant supply to be maintained.

In some cases it is found that the water at command is not sufficient to work a ram continuously. For such instances an

apparatus has been designed which allows the ram to be worked at any desired interval, and being perfectly self-acting it can always be relied upon. It can be applied to existing rams if necessary.

It is possible by the use of a ram worked by impure water to obtain a supply of pure water, for potable and other purposes. These rams are specially constructed, and are more expensive than the ordinary kind, but are equally self-acting. The pure water is generally obtained from a well some few feet deep sunk near the ram, into which the water filters from the supply or waste water used in driving the ram, or from some other natural source. The water is pumped from the well by the ram, and is forced through pipes to the point of delivery. This has given the name of "Pumping Rams" to machines of this class, and they are found to be very useful.

I have given full particulars of these machines, because I know of many which have been fixed in unsuitable situations, or which from one cause or another are not working satisfactorily. A good ram properly fixed in a suitable position is one of the most efficient water raisers it is possible to employ.

It must be borne in mind that to make water power available in this way, or in any other, a material volume and a material fall are necessary. The efficiency of the hydraulic ram averages about 60 per cent., but taking 50 per cent., which is a perfectly safe calculation, the duty it will perform is as follows: — Suppose a fall of 10 feet and a quantity of 100 gallons per minute, the ram will raise $\frac{100 \times 10}{100} \times \frac{1}{2}$ = 5 gallons per minute or 7,200 gallons in 24 hours. Of course the ram works continuously night and day, supposing the supply to be constant. It may be said roughly that the ram raises one-twentieth the quantity of water which passes through it, ten times the height of the fall.

Water wheels.

Water power may be utilised also to drive water wheels in situations where sufficient fall in proportion to the lift cannot be obtained to ensure the satisfactory action of a ram. This

is frequently the case where a watercourse in a valley furnishes the motive power, and although the supply of water is ample, a small fall only can be obtained. Usually a set of three-throw pumps is driven by gearing from the wheel shaft. An overshot wheel is more efficient than an undershot wheel, but the latter is very convenient for utilising low falls ; some will work with falls as low as one foot only.

New pumping water wheel.

A patent double acting pumping water wheel has lately been introduced, and has been fixed on many estates with success. I am now fixing these machines in several places, amongst others at railway stations on the Maidstone and Ashford Railway.

This wheel possesses the same advantage as the pumping ram in the matter of supplying clear water when the stream is turbid, owing to rain or other cause, or where the water is impure. In such cases the pump is arranged to draw its supply from a well, into which the water from the stream percolates through the surrounding soil, or if that is unsuitable through a bed of gravel interposed between the well and the stream. It is thus naturally filtered and delivered quite clear, for domestic as well as for fire purposes. The wheel is somewhat better to manage, and is not so complicated as the pumping ram, and costs very little in repairs.

The standard wheel of this class is 3 ft. in diameter and 1 ft. wide. The buckets, shrouding, arms, and bosses are all cast in one piece complete, a *chef d'œuvre* of the founder's art which never fails to attract attention. The whole is galvanised to prevent rusting, and it is thus practically everlasting. It is fitted on a substantial frame. The wheel is fitted with one or two pumps as may be required, which are constructed of gunmetal, fitted with phosphor bronze valves, and are of the piston and plunger type, which only require two valves instead of the four which are required in the more ordinary form of double acting pumps. These wheels have been made up to 10 ft. in diameter, cast in three parts.

It is advisable, if possible, to have 5 ft. fall for a wheel 3 ft. in diameter, but it will work satisfactorily with rather less if this cannot be obtained.

Turbines and pumps.

The turbine as a water motor is not generally familiar, and is therefore but little used for pumping purposes, although in some instances it is by far the most suitable appliance that can be adopted, especially in districts where floods are prevalent. The rising of the tail water does not affect the working of a turbine, except in so far as the available head of water is reduced, the power evolved, of course, being also reduced in proportion.

A turbine wheel can be set in an open well; where it is admissible, this is the best and least expensive method that can be adopted.

The water is led to the outside of the turbine house by an open channel, and then passes through the intake, which is of brickwork, and contains a wrought iron bar strainer to prevent floating matter entering the well. A pipe fitted with a flap valve admits the water to the well, which, after passing through the turbine, is led away either by an open channel brick culvert or by whatever means may be the most convenient.

The turbine drives a pair of ever charged pumps, the gearing, &c., being carried by an elegant cast iron framework, which with the pumps is bolted down to a cast iron floor plate covering the wells, provided with a manhole and cover. The air vessel is separate, and both pumps deliver into it. The regulating spindle of the turbine terminates with a hand-wheel, which is conveniently placed for stopping and starting the turbine.

This arrangement is very compact and self-contained, and is capable of dealing with large quantities of water. Turbines can be made in all sizes suitable for any height of fall; they can be used for falls of one or two hundred feet, as well as for those of two feet.

"A twenty-horse power turbine on a hundred feet fall,"

says Mr. Rich, "would only be about the size of a dinner plate."

I would remark that too great care cannot be taken in deciding on what is the best means to adopt for utilising an available supply of water. It is a question in which one is very apt to be misled, and amateur engineers advocate the use of a ram, pumping, water-wheel, or turbine, without paying the slightest regard to the conditions under which the machine has to act, and which ought to govern the choice. The best way is to give full particulars of the site and requirements to some well-known maker of water raising machinery, and leave it to him to decide on the most suitable appliance for the purpose.

Mechanical means of driving pumps.

Pumping machinery can be driven in many different ways mechanically; by steam, hot-air, or gas engines, or by wind, horse or manual power. Pumps themselves, as Mr. Colyer in his work upon Pumping Machinery observes, are frequently made in a very indifferent manner by "pump makers;" engineers, with the exception of fire engine makers, do not care to have much to do with them owing to the unfair position they are placed in by the manufacturers of the nasty and cheap. "The use of inferior pumps is very false economy, as the bad results they give in working, and consequent loss, much more than counterbalance the first cost of really good and well-made apparatus." It is always desirable in order to avoid incessant "breakdowns" and loss and danger therefrom, to insist that first-class pumping machinery only is fitted up.

Steam engines.

Steam driving engines are so well known that it would be waste of space to make any remarks about them, except to say that "cheap" engines like "cheap" pumps are always to be avoided. They are invariably unreliable, wasteful machines, and as a rule cause great trouble, expense, and inconvenience, by incessantly breaking down. Steam engines are in my opinion to be preferred to any other kind of mechanical power for driving pumps, whenever large quantities of water have to

be raised. They can frequently be arranged to perform other duties also upon an estate, such as driving farm machinery, sawing machinery, &c.

Hot air engines.

Hot-air engines are simple and inexpensive machines: although used somewhat extensively for the purpose, the principle on which they are constructed is still novel to many persons. To the non-mechanical the hot-air engine looks like an ordinary horizontal engine of a short stroke, but with a cylinder of rather larger diameter. It is, however, an engine without a boiler and without steam, the cylinder having to play the part of the former and the air in it the part of the latter. The end of the cylinder is built in a slow combustion furnace, which requires attention about two or three times a day. As the cylinder becomes heated—it finally attains a dull red heat—the air in it expands, and the piston is forced out and works the crank, in the manner of an ordinary steam engine. The expanded air now requires to be cooled. This is accomplished by a smaller piston called the displacer, which, being forced into the air space by means of a crank action, drives the hot air to the front end of the cylinder, where it is cooled by a surrounding jacket of cold water. The ensuing contraction produces a partial vacuum, which assists in sending back the larger piston to its original position, so obtaining the return stroke. The alternate expansions and contractions take place in a much shorter time than would be imagined; a model has been made in which the operations are accomplished a thousand times per minute.

Gas engines.

The gas engine is another useful motor for pumping purposes. The principle of these machines is too well known to render a description necessary; they are now made to run with the smoothness and regularity of speed of a steam engine; they have few working parts, and they possess the great advantage of starting at full power immediately the gas is lighted; they require no boiler or furnace, and need little in the way of repairs and renewals.

Comparative economy of steam, hot-air and gas engines.

In a recent number of the *Engineer* I find an account of some experiments undertaken in America for the purpose of testing the relative commercial efficiency of the steam, hot-air, and gas engine. The experiments were made with engines indicating eight-horse power actual. The cost of one-horse power per hour, including fuel, water, lubrication, attendance, depreciation, and interest, is given at $3\frac{1}{2}$ cents for the steam engine, 4 cents for the hot air engine, and $8\frac{3}{4}$ cents for the gas engine; the price of the gas being calculated at ten shillings per 1,000 cubic feet! If the gas is charged at three shillings per thousand, the cost will be almost exactly the same as that of the steam engine. I am inclined to attach but little value to these experiments, but I think there is no doubt that the cost of running these motors is about the same in each case.

Wind power.

It is occasionally possible to utilise wind power; but in this country wind is a very uncertain agent, and I think that on the whole it will be found most satisfactory to ignore it altogether in connexion with constant supplies of water for any purpose. Many excellent designs of wind mills for raising water are obtainable; American machines are deservedly held in some repute, but their best features have been adopted by English manufacturers.

Horse-power pumps.

Horse power may be employed under some circumstances, but it is not recommended either in respect of its economy or its results. A horse will raise on an average about 600 gallons per hour to a height of 100 feet; thus, working seven hours a day, 4,200 gallons would be pumped, and it would require a week's work to fill a 25,000 gallon cistern, which is not a very large one for fire purposes. Mules and donkeys are similarly used, and considering the low cost of feeding them, their work is probably much cheaper than horse labour. When a horse is employed it should be harnessed to an ordinary horse-pole, and should tread a circular path about 24 feet in diameter. It should drive a three-throw pump, and should walk at a pace of about two and a-half miles per hour.

Hand-power.

Hand power pumps are very commonly used for the domestic supply of smaller residences; but they are of little value anywhere for fire purposes, and even for the household supply in large mansions they are ill adapted, the quantity of water daily required for modern sanitary apparatus being much larger than a hand pump will provide economically. A man will raise, as an average quantity, sixty gallons per hour to the height of a hundred feet; so that two men working together would hardly raise a thousand gallons in a day of eight hours. It is evident therefore that handpumps are not worth considering as a possible means of raising the quantity of water necessary for efficient fire service.

External storage.

As an important factor in a gravitation system underground reservoirs claim a word of notice. They are usually made of bricks or stone built in Portland cement or hydraulic lime mortar, and covered over with stone slabs or arches of masonry. The bottom should as a rule be formed with inverted arches, with or without a bed of concrete under, or with concrete alone, according to the nature of the ground. The sides and bottom of the reservoir should be rendered in Portland cement well trowelled, and if there is any danger of surface water penetrating the walls, they should be backed in well worked clay puddle, at least 12in. thick, precautions being taken, if the tank is covered by an arch, to prevent the side walls, if thin, from being thrust outwards against the soft clay. On the other hand it is often desirable to introduce one or more transverse division walls in cases where the ground is likely to exercise a thrust inwards. In building a tank it is of primary importance to prevent unequal settlement, or any movement of the walls that would cause leakage. Underground reservoirs should be constructed in two or more compartments, to admit of their being cleaned without interfering with the water supply. Each tank should have a man hole; also an inlet, outlet, and overflow pipe. A covering of 12in. to 18in. of sand or earth will keep the water cool in summer, and prevent it from freezing in winter. All covered tanks should be properly ventilated.

Where height is desirable they should be made circular. The pipes from a spring to the reservoir may be comparatively small; but from the reservoir to the mansion larger pipes are necessary; four inch or six inch are usual sizes, and the former should be considered a minimum.

Internal storage.

The water being brought by gravitation power or by pumping to the house, it should be circulated in mains surrounding the mansion, having hydrants at suitable distances for throwing water upon a fire from the outside, and a connexion should be made, with pipes leading into the mansion, and taken up a stairway, lift, or light well, or in the most convenient manner possible, to a tank on the roof or in a tower of the building. In a subsequent chapter upon fire apparatus I shall mention particularly how this tank should be constructed. Cast iron tanks are best wherever they can be used, but if on account of weight it is not possible to adopt them lead-lined wood cisterns or galvanised wrought iron may be employed. It is very desirable to have different cisterns for the domestic and fire supplies in order to avoid any chance of the tank being empty on an alarm of fire being given. When fixing tanks I always advise the fitting up of a tell-tale arrangement with a dial face in the steward or butler's room, by means of which it can be seen at a glance whether the fire tank is full or not.

Value of a good supply of water.

A good supply of water is most valuable in a house, and in a large mansion there is scarcely an end to the services it may be made to perform. Apart from ordinary domestic duties, it can work coal, luggage, or "passenger" lifts; it is by far the best, almost the only available auxiliary in sanitary matters; and there is no reason why it should not turn the spit in the kitchen, the lathe in the workshop of the clerk of works, the grindstone and circular saw in the carpenter's shop, and blow the organ. The quantity of water it is advisable to provide for any house may be stated at fifty gallons daily per head of its inmates, the same quantity for each horse in the stable, five hundred gallons for each acre of garden; and,

according to the size of the mansion, from twenty to a hundred thousand gallons always in the tanks for fire purposes.

External supply from lakes, ornamental waters, or running streams.

If there is a lake, ornamental water, or running stream in the grounds at a reasonable distance from the house it is probably easy, without carrying out any very expensive works, to do something towards adapting it to fire purposes. Should the water be quite close to the house it is only necessary to see that a convenient spot is prepared for the private engine and for the engines belonging to any public brigade that may attend to get readily to work. If there is a pond, the bottom of which slopes very gradually towards the centre, a place near the edge should be deepened so as to give a depth of water at the margin of two or three feet, which will enable the fire engines to take suction much more readily. I have frequently been at fires where this operation has had to be carried out with spades and shovels, whilst the fire was blazing away and the engines stood idly by.

Suppose, again, the water is ample in quantity, but is situate fifteen hundred or two thousand feet distant from the mansion. A steam fire engine working at the water side would exhaust a large portion of its power in overcoming the friction in the hose. In this case it is desirable to lead the water by a pipe, four or five inches in diameter, to a covered tank sunk in the ground near the mansion ; the supply to this reservoir is easily regulated by means of a ball cock or command valve. The same engine, which, working fifty feet from the seat of the fire, would throw half a dozen large streams with good force upon it, working fifteen hundred feet would throw only two streams. If a manual engine worked by 30 men were placed at the greater distance, it would throw only a very small stream upon the fire with any force ; but working from the reservoir close to the mansion it would give two or even three excellent jets.

CHAPTER IV.

DEFECTIVE FIRE APPARATUS.

UNSUITABLE APPARATUS COMMON IN PUBLIC AND PRIVATE BUILDINGS — PLUMBERS' FIRE PROTECTION — DEFECTIVE APPARATUS AT A FIFESHIRE CASTLE—CAUSE OF DEFECT—REMEDY APPLIED — RESULT OF THE ALTERATIONS — ANOTHER INSTANCE—DEFECT AND REMEDY—DEFECTIVE SYSTEMS—ERRORS IN DETAIL—IN FIRE VALVES—HOSE—BRANCHPIPES AND NOZZLES—LETTER IN THE "FIREMAN."

Unsuitable apparatus common in public and private buildings.

WHEN inspecting the fire arrangements of both public and private buildings, I have very frequently been shown a great deal of costly machinery, quite unsuitable for the purpose it was intended to serve. In the majority of cases, this has been procured at the instigation of some inexperienced person; usually by the advice of a plumber or builder, acquainted with fire protective appliances only as one of the occasional incidents of his business. Sometimes, with a little more success, recourse has been had to the local fire brigade superintendent. This gentleman is probably very well acquainted with the drilling of his men, and the manipulation of his apparatus at fires; but he is, as a rule, not competent to deal with matters which belong exclusively to the province of the fire engineer. The fire engineer is by no means infallible, but his experience will enable him to avoid gross errors in every instance, and to grapple with the question of the efficient protection of a large building, whatever the difficulties may be, in a tolerably complete and intelligent manner.

Plumbers' fire protection.

There are numerous residential mansions in every county in England, furnished only with what I may call plumbers' fire

protection; they are supposed to be securely guarded against an outbreak, but the supposition is not at all justified by the fact. The defects incident to plumbers' fire protective apparatus are of two kinds; first in principle, and then in detail. I might easily give a large number of instances in which ignorance and incompetence have caused many hundreds of pounds to be thrown away upon a thoroughly worthless fire system. Some six months ago I was asked to visit a large castle in Fifeshire, and report upon its safety from fire. I found an elaborate system of hydrants and pumps, which must have cost at least three times as much as was necessary; but it was all quite useless, in consequence of the perpetration of a piece of stupidity in connexion with the water supply. There was a reservoir about five miles distant, at a great height, and capable therefore of supplying a splendid pressure of water; it was quite four times the height of the topmost part of the castle turret. The water was conveyed some distance by a 6-inch main, which decreased to a 3-inch main; the 3-inch pipes took down the water to supply a village in a valley about 50 feet below the castle level; but the pipes to the castle itself were only $1\frac{1}{2}$ inches in diameter, and the consequence was that when I had a hose attached to one of the castle hydrants, a small jet of no force squirted up to the first floor windows. This jet would have been of no use whatever for fire extinguishing purposes; whereas, with pipes of the proper size, a dozen powerful jets could easily have been sent a hundred feet above the turret. In connexion with this $1\frac{1}{2}$-inch pipe, other pipes were carried to cisterns at various elevations inside the building, and from these again more pipes were taken to all parts of it, with hydrants in various positions; but all were so small that not one would give a stream sufficiently powerful to quench a fire which had obtained a hold upon the place.

Defective apparatus at a Fifeshire Castle.

Cause of the defect.

In this instance the remedy fortunately was very simple. I first traced out the 6-inch main, and fixed upon a point

Remedy applied.

for an intercepting reservoir, at a height which gave about 150 lbs. pressure at the Castle. By a simple valve combination the flow of water for the village was arranged so that it did not interfere either with the quantity or pressure available at the Castle in case of fire. This reservoir was about half-a-mile from the Castle, and from it I directed 5-inch pipes to be laid. They were brought up to the grounds, and continued round the building with hydrants at convenient positions. The result was that at the test I made on completion of these alterations, the clerk of works and other capable servants assisting, within two minutes from the alarm being sounded six large streams of water were poured with great force upon the spot where the fire was supposed to be raging. All the apparatus previously fixed was utilised, of course at some considerable outlay, and the old effete system was rendered useful and complete. But a great deal of money would have been saved had the work been properly done at first; and at any time before my visit the Castle might have been gutted without the smallest chance of a "stop" being effected by the inmates. There was an exactly similar defect in the water arrangements at another large residence I visited; a reservoir was situated two miles distant, but the pipes to the house were again not of sufficient capacity. In addition there were six junctions to the pipes, which carried water to lower levels before reaching the mansion. Hence the quantity and pressure were both deficient. In this case I found it best to adopt another method of remedying the defect. Indoor hydrants were fixed in the passages upon each floor, connected to pipes which led from a tank on the roof. The supply in this tank would be sufficient to keep any ordinary fire in check, until the supply in the reservoir could be brought into service, and in order to utilise it as well as possible a sufficiency of small hand fire pumps was provided. To bring into action the supply of water stored in the reservoir, I fixed at each of the junctions with

Result of the alterations.

Another instance.

Defect and remedy.

the mains, which carried off the water to the lower districts, a valve, which could be instantly shut down. The men about the stables were drilled to gallop off immediately upon an alarm being given to shut off these junction cocks; the whole could be closed in ten minutes, and the entire supply was then turned into mains, which were connected with hydrants laid *outside* the building.

Defective systems.

Defective systems are common enough, especially in cases where the owner is unable personally to give attention to the matter. I consider any system defective which is not the *best* that could possibly be adopted for any particular mansion or estate, and I have frequently noticed that the expense of fitting up faulty systems must have been largely in excess of what would have been incurred had the correct thing been done.

Errors in detail.

I will suppose, however, that the best *system* of fire protection has been adopted, there come in then many little matters of detail, which if neglected through ignorance or prejudice may vitiate the very best system, and render the whole useless when a fire actually occurs. I will take indoor appliances only. One would imagine there could be little variation in the simple iron pipe with its hydrant, length of hose, copper nozzle, and spanner; the fact is that large numbers of buildings, even in the heart of the City of London, are fitted up with apparatus of this class, more worthy of the days of Tubal-cain than of the nineteenth century.

Fire valves.

To begin with fire hydrants. I notice in the catalogue of a single manufacturer two hydrants of quite different construction, one of them quite right, and the other quite wrong in detail. No 1 is probably the hydrant the manufacturers would recommend. The pressure of the water when the hydrant is fixed is underneath the valve, so that the pressure does not act on the gland packing; there is therefore no continual leaking through the soft packing, and the packing itself may be renewed without shutting off the water from

the main. The water being excluded from the body of the valve is not liable to freeze. The pressure being underneath, it assists the valve to rise from its seat when the screw is slackened, so that the hydrant is rapidly opened upon an emergency. This hydrant is such an one as an engineer would make and fix; and its advantages are so well understood that all the best service cocks in houses, steam stop valves, ground hydrant valves, &c., &c., are made upon the same principle.

No. 2 is a fire hydrant, in every respect the opposite of number 1. When fixed, the body is always full of water; it is therefore readily damaged by frost. The pressure being continually on the gland packing, the water gradually soaks through and drips. If the gland has to be repacked the firemain must be first emptied. When the hydrant is to be used, it is necessary to use considerable force to open the valve against the pressure upon it; this is a serious objection, for the safety of valuable property and many lives may depend upon the ability of some servant girl to bring the apparatus to bear upon a fire at the first moment of its inception. These objections are so well known to engineers that they never, unless compelled to do so, supply a valve for any purpose constructed upon such principles.

Starting from the hydrant, I come next to the hose. Good hose of any kind is always reliable, but there is a best kind as well as a best quality. The most durable and serviceable hose is that made of leather; but indoors, it is often necessary to have it waterproof and clean, and the only description of hose to which these adjectives can be applied is that made of canvas and lined with rubber. There is a most extraordinary quantity of worthless canvas rubber lined hose in London. I lately saw a couple of lengths which were some two years old, and had never done any more arduous duty than hanging in the corridors of an hotel, where the even temperature and favourable atmospheric conditions should have preserved them for generations. Noticing some ugly symptoms in their

Hose.

inside, I asked if they had ever had water through, and was told no; the proprietor would have them tested at once. I advised him to carry out the test upon the external hydrants, in mercy to his walls and ceilings, and it was well he did so, for at forty-eight pounds pressure both lengths burst badly. It is almost impossible for the most experienced fireman to detect shoddy in well got up worthless hose of this kind, and that is one sufficient reason why rubber lined hose should always be avoided unless it is absolutely necessary to have waterproof hose. Good plain canvas, hand woven, is much better; it is less liable to deterioration, and may be relied upon, at least for a time. Good leather hose, properly attended to, always keeps its good qualities; in fact, it improves with age, and only want of care or very hard work will cause it to fail; and then repair is easy and inexpensive.

A frequent fault in connexion with fire hydrants and hose supplied by plumbers and builders is this—the couplings are screwed to a very fine thread with a knife edge; the slightest blow upon the outlet of the hydrant will cause such damage as to render it impossible to connect the two. Often the hose screws scarcely pretend to be threaded to the same pitch as the hydrants: this defect, of course, brings about the same result. Even the copper branchpipe may be, and often is, made wrongly, and there are so many ways in which the nozzle may be made, so as to give the very least possible duty, that I am well within the mark in saying that fully one half of those now in use are made upon vicious principles; the size of the discharge orifice is also frequently determined without the smallest consideration to the pressure of the water available.

Branch-pipes and nozzles.

Some curious examples of the way in which defective and useless apparatus has been introduced into large buildings are given by a writer in the *Fireman*, page 201, April, 1883. They are worth reproduction. The writer says:—

Letter in the "Fireman."

"One or two instances have recently been brought to my knowledge which show the utter absurdity of entrusting people without a proper knowledge with the arrangements upon which

the safety of valuable property depends at an outbreak of fire.

Narrow escape of the mansion at Blackmore Park.

"There was an ancient and splendid mansion at Blackmore Park, belonging to one of the oldest of our old English Catholic families. Some three years ago this was the scene of an immense conflagration. The work of re-construction was proceeded with in due course, and the family were to re-occupy it early in the month of February last. When the mansion was in course of re-building, a local engineer was entrusted with the fire protective arrangements.

"A few hours before the family were to take up their residence the mansion was again discovered to be on fire. Thereupon recourse was had to the hydrants fixed on the different floors by the engineer just mentioned. Not one of them could be brought into use. The first one tried was found to have its cap secured in such a way that disconnexion was impossible. The entire body of the second was unscrewed in the endeavour to take off the cap, and, as a matter of fact, no part of the fire apparatus was in such a condition as to enable a jet to be brought to bear upon the flames. Fortunately the servants were able to keep the fire in check by means of water cans and buckets, and upon the arrival of the Upton and Malvern Fire Brigades danger was found to be at an end. But the mansion undoubtedly escaped by the skin of its teeth.

Absurd and useless fire apparatus.

"I might multiply many instances of the most absurd and utterly useless fire apparatus which from time to time has been brought to my notice, usually fitted up by gas engineers or plumbers, who have bought the hose and fittings from fire engine makers, charged a good profit thereon, and contrived the water supply arrangements themselves. The following, however, will suffice :—

I.—Elaborate fire hydrants and hose throughout a building, with a maximum water pressure of 15lbs. per square inch, where a much less expensive arrangement would have secured 70lbs. In this instance the nozzles were large enough for a steam fire engine stream.

II.—Hydrants fixed beyond the reach of the water pressure altogether.

III.—A score of cases in which the hose couplings were quite a different thread from the hydrants, and could not possibly be coupled on to them.

IV.—Six hydrants, each with two lengths of hose, and one branch pipe (which did not fit) to the whole.

V.—Fire cocks with no hose whatever. The building referred to is a school in the E.C. district; there has never been any hose, and the managers having taken the matter into consideration, called in their plumber, and, on that gentleman's instigation, decided it was not necessary, as the brigade's hose could be used. An utter fallacy, as no hose in the brigade would fit these cocks.

Reductions in Insurance premiums.

"I believe insurance companies are now allowing large reductions from their premiums in cases where proper protection from fire is provided. Their surveyors should see that proper protection is provided; for much of the apparatus I have seen, which purports to be for the purpose, would be exactly as much use as no apparatus at all if a fire broke out. The only way in which to secure appliances really valuable is to call in some firm or person who makes such work a speciality, and has experience in it. It is also a much less costly proceeding, for in the long run it always has to be done, sooner or later, and a double expense incurred. This has been the case within the last few weeks at the Reform Club, where some apparatus, fixed by a firm of hot-water engineers, was found practically next to useless; at the Bank of Montreal, where the builders had the matter in hand; and at many others I could name, if I thought, Mr. Editor, your patience would hold out while I told the story. I fear, however, from past experience, it will not, so these must for the present suffice."

CHAPTER V.

FIRE APPARATUS.

APPARATUS SHOULD BE SUITABLE FOR THE BUILDING—INTERNAL AND EXTERNAL APPLIANCES—FIREMAINS AND HYDRANTS—TANKS MUST BE PLACED AT A SUFFICIENT HEIGHT—PORTABLE HAND-PUMPS AND BUCKETS—CISTERNS—FIREMAIN PIPES—HYDRANTS—HOSE—REELS AND OTHER FITTINGS FOR HOSE AND TOOLS — BRANCH-PIPES — PRESSURE AUGMENTER—HAND FIRE-PUMPS AND BUCKETS—CHEMICAL FIRE ENGINES—HYDRANTS ON EXTERNAL MAINS—STEAM FIRE ENGINES—MANUAL FIRE ENGINES: THE LONDON BRIGADE MANUAL—THE MANSION FIRE ENGINE.

HAVING proved how easy it is to acquire systems of fire protective appliances which are incapable of affording protection, and to carry out a proper system in such a way as to destroy, by inattention to some apparently trivial detail, its whole value, it remains for me to show what are the appliances which can best be employed for the purpose, and how they should be disposed with the view to their being promptly brought into action when occasion demands.

Apparatus should be suitable for the building.

The most important point to bear in mind is that the apparatus should be designed to meet the peculiarities of each particular building. What is the most suitable for one may be useless or not so valuable for another of different size or situation.

Internal and external appliances.

I will divide this part of the subject into two, dealing with apparatus suitable for internal use separately from that employed in extinguishing fires from the outside of the building. The great advantage of coping with fire at close quarters is apparent; and for this reason, and because they

can be brought into instant application, internal fire arrangements must be considered to be the most valuable and important.

INDOOR APPLIANCES.

Firemains and hydrants.

The usual appliances provided for the purpose consist of fire mains, taking their water supply either from external sources or from a tank placed on the roof or in a tower of the building, having hydrants on each floor, with the necessary hose and nozzles attached to each hydrant.

Tanks must be placed at a sufficient height.

Unless the height of the roof or tower is sufficient to give a good water pressure in the mains, this plan is not available without the assistance of the pressure augmenter, which I shall refer to later on. A common, and altogether an inexcusable error, is to place a large tank at a low elevation, the perpetrator of the deed being under the impression that a great quantity of water will be instrumental in putting out a fire, notwithstanding the small force with which it can be brought into contact with the flames. It should be borne in mind that under such circumstances water is not a solid weight in the pipes; there may be fifty thousand gallons in the cistern, but if the cistern itself is only two feet above the seat of the fire there will be less than 1-lb. per square inch pressure at the jet, so that the water will only trickle out of the nozzle, and will be quite impotent for fire purposes.

The number of lbs. pressure per square inch at the nozzle is somewhat less than half the number of "feet head" of water in the pipes; fifty feet head of water gives 21.68 lbs. per square inch, and this is the very lowest serviceable pressure.

There are sometimes reasons why hydrants should not be fixed inside the building, especially in the basement and ground floors. In such cases it is well to keep hose and nozzles hanging in the upper floors: in the event of fire, one end of the hose can be lowered down the staircase or lift well, and connected on to one of the outside hydrants, and the apparatus at once brought into play. I have carried out this

system in connexion with many buildings, amongst others at the Queen's Hotel, Eastbourne, where it answers admirably. Its adoption avoided a large expenditure for cutting away walls and stone flooring, which must otherwise have been incurred. Although not quite so rapidly brought into action as that of hose connected to hydrants on each floor, it is still a practical and ready method.

Portable hand-pumps and buckets.

As auxiliaries to the large streams obtainable from the hydrants, it is well to place upon each floor a small hand fire pump, with leather buckets, for use when a fire is discovered very early, and when damage by water consequently can be avoided. These little articles are always handsomely finished and painted, and may be artistically disposed in the halls and upon the landings. Chemical fire extincteurs are also useful as adjuncts to other appliances, but for reasons which I shall presently give they are not to be relied upon in the absence of other means.

I will now endeavour to deal with the various appliances in detail.

Cisterns.

When fire appliances are being fitted up in new buildings, cast iron tanks are preferable to any other kind; but on account of their weight they cannot always be used in old buildings, where galvanised wrought iron or wood lined with lead must be employed. At the Langham Hotel there are two of the finest cast-iron tanks in the country at an elevation of a hundred and ten feet above the ground, and there are also some very large tanks at Montague House, Whitehall, the town residence of His Grace the Duke of Buccleuch. The latter are placed above the roof of the main building, but they are roofed in themselves; they are supported upon girders, a space being left all round for purposes of examination, repairs, and painting. At the new Law Courts similar cast-iron tanks are fixed at a still greater elevation.

At Rufford Abbey I had a large tank to fix in an old tower; a cast-iron tank could not very well be adopted on account of its weight. I erected, therefore, one of wrought iron, the

plates being made in sizes and shapes specially to suit the space the tank was to occupy; they were hauled up into position and rivetted and bolted together there. Upon another occasion I had to deal with an old country seat, the roof of which was intercepted with beams and girders in almost every conceivable position. A very large quantity of water for fire purposes was required, and in this instance a series of cisterns was constructed, the whole being placed on a level, connected by means of suitable short pipes. When joined they were, of course, similar to one large tank; and the downright main which carried the hydrants was attached to one of the divisions only. Slate tanks and wood tanks lined with lead may also be employed, but they are objectionable on account of the ease with which they are destroyed should the fire reach them. Cisterns, of whatever material they may be constructed, must be carefully proportioned and of adequate strength for the weight they have to carry. Instances of tanks bursting from sheer weakness are not rare; an accident of this kind took place some time since at the Middlesex Hospital, and more recently at the Crystal Palace; the damage occasioned was in both instances considerable.

Firemain pipes.

The fire mains both inside and outside a building should be of cast iron, and never less than three inches in diameter, if a really efficient jet of water is to be put upon a fire. They should be coated with a suitable composition to prevent rust, and have easy bends and special tee-pieces where the direction is changed so as to help forward instead of retard the flow of water towards the hydrant. This desirable arrangement is frequently lost sight of, even by Water Companies in the laying of street water mains. Wrought-iron pipes, galvanised, may be used inside a building if the mains are less than three inches in diameter. I have frequently seen, in old mansions especially, water pipes as well as gas pipes of lead, the astute plumber never having considered the possibility of their melting or of their being gnawed by rats. I noticed lead

pipes in country houses destroyed by rats on three occasions within a period of six months.

The strength of fire main pipes must be adapted to withstand not only the pressure within them, but also the shocks which are occasioned by the pressure being suddenly turned on and off. Some few years ago I recollect a fire taking place at a well-known public building where light cast-iron mains had been erected in connexion with tanks upon the roof. The fire broke out in the basement of the building, and the sudden opening and shutting of the hydrants caused such a concussion that the main pipes split vertically. The pipes had to be taken out, and stronger fitted in their place, and to prevent the chance of the recurrence of anything of the sort large air vessels were fixed in convenient positions to equalise the pressure; this was, of course, effective, and no similar accident is to be looked for there under any circumstances.

Hydrants.

The hydrant or fire cock, as it is usually termed, is one of the most important parts of the whole apparatus, and it is therefore most desirable there should be nothing wrong with it. It must not be liable to freeze, nor to "stick fast," if not opened for a short time, nor to leak when shut; it must not under any circumstances be difficult to open, nor liable to accident of any sort. It is amazing how much ignorance exists in connexion with these very common articles; even experienced fire brigade superintendents have been known to recommend fire valves of the most inferior construction, and made in violation of every good principle, such as would be well known to an engineer's apprentice. In the chapter upon defective fire apparatus, I have mentioned in particular one very bad class of hydrant which is in very common use. It is sufficient to repeat respecting it that the whole pressure of water, when the hydrant is fixed, is upon the "packing" which keeps the valve from leaking, consequently that this hydrant is almost always dropping water upon the floor beneath it; that when this packing has to be renewed, the whole fire main must be emptied; that the body of the hydrant is always full

of water, which, therefore, in frosty weather has the finest possible chance of freezing; and that before the hydrant can be opened, the whole force of the pressure of water in the mains has first to be overcome. A fire cock made on good principles presents the exact opposite of all these features.

What is known as the "plug" fire cock is objectionable on account of its being difficult to open after a short period of disuse. The "gland" fire cock is to be avoided for an exactly similar reason. The rack valve hydrant will frequently leak, especially if a piece of grit happens to get between the valve and the face; otherwise it is unexceptionable. The best kind is one which consists of a valve of metal, leather covered, shutting down upon a face cast within the body; the pressure when fixed being beneath the valve, so that the body of the hydrant is empty when the valve is closed; when it is required to open it, the pressure assists the valve to rise.

Hose.

The best description of hose, on the whole, is in my opinion that made of leather. Leather hose has not one advantage which attaches itself to some other kinds, it is not waterproof; but it is in every other way most undoubtedly superior to any other kind. It is more reliable and far more durable either than plain canvas, or than canvas lined with india rubber. Leather hose has been known to last forty or fifty years with moderate care and attention; twenty years does not at all constitute a long life. I do not know of any other kind which will last more than four or five years. Canvas is very liable to deterioration from rot or mildew, and as this kind of hose is not even waterproof it should never be adopted for use inside a house, but if a great quantity is required for external uses, hand woven canvas hose may be partially employed. India rubber hose, and canvas lined with india rubber, are both waterproof; but, as is well known, the nature of rubber is to perish, and neither of these descriptions of hose should be selected, unless the outlay necessary for a fresh supply within a few years is not a matter of consideration. For

outdoor use, with steam and manual fire engines, leather hose should invariably be used: its porous qualities are here of advantage; the "sweat" through the pores of the material will do no damage, or comparatively none, and will go a long way to preserve the hose itself should it come into contact with hot embers, &c., at an actual fire. Of course there is some advantage in having waterproof hose for use indoors, because much less damage will be occasioned by water in the extinction of a small fire.

Reels and other fittings for hose.

It is possible to repair leather hose, but no other kind can be effectively repaired. It is usual to keep the hose coiled upon a polished board of mahogany, walnut, or oak, whichever matches the internal fittings of the mansion, the branchpipes and other small tools being also arranged upon the same board. Occasionally a cupboard is preferred. During the past few months a very ingenious plan has been introduced, by means of which the hose is kept always full of water ready for instant application. It is wound upon a reel which is connected by a watertight joint to the water main, a cock being fitted at the junction to turn off the water when required. There is another shut off cock on the nozzle. The hose is wound upon the reel and connected to it by a union. Under ordinary circumstances the cock at the junction with the main is open, and the hose, which in this case must necessarily be watertight, is full of water up to the nozzle cock. Should fire break out it is only necessary to take the end of the hose in the hand and walk towards the fire, the hose uncoiling as you proceed; then on opening the nozzle tap a jet of water is immediately obtained.

Branch-pipes.

The branchpipes are the discharge pieces fitted to the end of the hose for directing the stream; they should always be of copper and about nine inches or a foot long. This gives just sufficient length to enable them to be grasped firmly and held in position, and more than this is not necessary. Leather branchpipes have been used, but they are slippery and greasy to the touch and cannot be held firmly; they are also liable to

kink and to interfere seriously with the stream, particularly when there is only a low pressure of water. The size of the brass nozzle at the end of the branchpipe must be carefully adjusted to the pressure and quantity of water; it must of course be larger the greater the pressure is. The same size nozzle will not do for both the top and bottom hydrant of a firemain in a large house; it is therefore important that each nozzle should be kept in its proper place and no change effected. The shape of the nozzle is of considerable importance; if the jet is not made correctly the water cannot be made to do its full duty. There are, as a rule, more absurd mistakes made in connexion with these little articles than with any other part of the fire apparatus.

Pressure augmenter.

The pressure of water in the top parts of a building where the supply is stored in cisterns is necessarily very light, and it is therefore desirable to use some means of increasing it. For this purpose I have introduced an apparatus which I call the hydraulic pressure augmenter. By its assistance a powerful jet of water can be obtained at a point even on a level with the bottom of the tank. I have already said that, however great the quantity of water held by the cistern may be, a good fire stream cannot be obtained except at a distance sufficiently below the tank to allow the power of gravitation to produce an effective pressure. In some mansions the height of the tank is not adequate to produce a good jet at any part of the building, and if the proprietor does not wish to incur the expense of providing other means of supply, the augmenter is a tolerable substitute. It is a fixture to the water mains, but is worked by hand power; I have had the apparatus fitted up at the Empress Eugenie's residence at Farnborough Hill, at Rufford Abbey, at Great Hadham Palace, at Laverstock House Asylum, at the General Post Office in London, and at many other places with such good results that although the water tanks are only from one foot to twenty feet above the level of the floors protected, a stream of water can be propelled through a hundred or a hundred and fifty feet of

hose, and come out at the nozzle with a force which will carry it forty five feet vertically or to a horizontal distance of more than sixty-feet. With this appliance, the water available, whether small or large in quantity, can be utilised to the very best advantage.

Hand fire-pumps and buckets.

These are, perhaps, the most common fire extinguishing apparatus, and they have certainly, for this reason and on account of their intrinsic value, saved more property in England from destruction by fire than all other kinds of apparatus together. The London Brigade Hand Fire Pump, as it is called, is to be found in mansions and in public buildings and fire brigades all over the world. It is a portable little appliance, weighing about 20-lbs. when empty ; the cistern holds six gallons, so that the weight when full is about 75-lbs. A powerful jet of water can be projected by it to a distance of thirty or forty feet, and the water in the pail being replenished by means of buckets as fast as it is used, a continuous stream of water can be directed upon the seat of the fire without exposing the person using the apparatus to the risk of personal danger or inconvenience. Half-a-dozen gallons of water, thrown upon the flames with the force which this little pump can exert, will frequently extinguish a fire that has obtained considerable proportions, with little or no damage by water to property not actually ignited. As a proof of the efficiency of this fire pump it is sufficient to mention that no less than 2,882 fires were extinguished by its instrumentality in London alone during the year 1882. It can be worked by a single person, even by a female servant or a boy ; the handle being moved by one hand, whilst the nozzle is held by the other.

The "Tozer" fire pump is the invention of Mr. Alfred Tozer, the able chief of the Manchester Fire Department, and is for its size and weight perhaps the most powerful pump in existence. Its cistern holds 12 gallons, and it weighs when full about a hundred pounds. One man can work it, but its full power cannot be developed by less than two persons.

It is advisable to place one or other of these pumps at each convenient spot throughout a large building. Half-a-dozen leather buckets should be hung above it upon ornamental brackets; or an ornamental pedestal may be used for the pump to stand upon, with brackets in front and at each side for the buckets. A small fireman's axe should also form a portion of the set. In order to add to the appearance of the pump and buckets, the coat-of-arms or monogram of the owner may be emblazoned upon them. The pump, pails and buckets should be kept two-thirds full of water, which ought to be changed every week. It is necessary to impress upon every servant in the establishment that the buckets are under no circumstances to be taken away for ordinary household uses, and to provide a small cock in the fire main upon each landing, for the purpose of readily filling the buckets in case of fire.

Chemical fire engines.

Chemical engines have been successful in trained hands in extinguishing many small fires, but I should hesitate to advise anyone to rely upon them. They are unsuited to mansions where no private fire brigade can be formed. My experience is that many servants are afraid of them, and that only a very few would have the presence of mind to use them beneficially at an actual fire, especially after the first charge has been exhausted. As a charge of chemicals, costing four or five shillings, is used every time one of these machines is tried, proficiency in working them is very rarely acquired, and in the hurry and excitement of a fire it is usually the case that the handiest pump or water bucket is brought into operation, whilst the extincteur is quite neglected. Although I have made a great many of these machines, I have never recommended their adoption, except where a trained fireman is in constant attendance. The best kind of extincteurs are made in such a manner that they can be brought into use by merely turning them over; in some of the older kinds a glass bottle has to be broken, but this is a very objectionable proceeding, the pieces of broken glass being sometimes difficult to expel from the machine. The principle upon which they work is

well known; by dissolving an acid and alkali in suitable proportions in the water carbonic acid gas is formed, and is forced under its own pressure from the nozzle in a state of solution. Undoubtedly water impregnated with carbonic acid gas is a most powerful fire extinguisher; but the disadvantages I have mentioned are very great, and seeing, too, that the chemical ingredients are not always readily obtainable, my opinion is strongly in favour of the simple hand fire pump, which uses only plain water procurable anywhere.

OUTDOOR APPLIANCES.

Hydrants on external mains.

Where water has been carried at high pressure in fire mains round the outside of the building, jets from hydrants furnish one of the most efficient means of protection. The hydrants should be placed not more than fifty feet apart, and the stream from them should have a force sufficient to carry it well over the highest part of the building. There are many kinds of outdoor hydrants. The chief points to be observed in making a selection are very much the same as those which have to be considered in respect of the indoor fire valves. They ought not to be liable to get out of order, to hold fast instead of opening, or to leak; and both the outside mains and the hydrants should be protected in the best possible manner against frost. It is as well not to have the mains too near the surface of the ground; a depth of twenty-one or twenty-four inches is a good medium. When a hydrant is to be brought into operation, a portable standpipe is screwed or fixed to the hydrant outlet, and the hose is coupled on to the standpipe top, which should then stand about six inches above the level of the ground. Leather hose should always be used with outdoor hydrants; it is the only hose which stands dragging about on rough paths without chafing through, and it will last much longer and be found more reliable than any other kind. The hose, branch pipes and other small tools are best kept in wood cupboards placed as near to the hydrants as can be done with a due regard to appearances.

Steam fire engines.

Where there is no water at high pressure surrounding a mansion, but a good supply in ornamental waters, or in a lake or stream, a steam fire engine should be adopted. It is in every respect superior to one worked by hand. The former can be brought into action by three men, in a few minutes, whilst a manual engine requires at least twenty; should a fire break out in the night so many might not be accessible. The cost of working a steam engine is about 2s. 6d. per hour for coal, oil and attendance; the cost of a manual engine for pumpers at 6d. per hour, and refreshments for these gentlemen £1 11s. 0d. The steamer will pump say 300 gallons per minute at 100 lbs. pressure at the nozzle; the manual about 100 gallons at 40 lbs. pressure. The only point in favour of the manual is its first cost, which is about half that of the steamer; but the consideration that sufficient men to work the hand engine might possibly not be procurable upon an emergency is so important that steam fire engines are now rapidly replacing hand engines upon all large estates.

It is often urged against these machines that they are difficult to understand, and some people consider them to be dangerous. By experience, however, it is found that any man who has so moderate an allowance of sense as is required to understand a portable engine such as is used for sawing, thrashing, pumping, &c., can readily manage a steam fire engine; it is as simple a piece of steam mechanism as can be made, and an intelligent farm labourer will learn all he requires to know during a couple of days' visit of an engineer from the makers' establishment.

Steam fire engines are made in all sizes, and are designed upon many different principles. The kind I most recommend is to be found in the mansions of the nobility and gentry in all parts of the country. The size must be regulated by the work the engine has to do, which depends mainly upon the size and height of the building and the distance the water is situated from it. H.I.M. the Empress Eugenie has lately purchased a steam fire engine which I may call the typical mansion

steamer. From a single jet this engine will throw water to a height of 160 feet and discharge about 300 gallons, or more than a ton per minute. There are two delivery outlets to the engine, but, when required, two other branches can be attached to these, and even with four nozzles at work water could be thrown from each over a tolerably high mansion. The engine indicates twenty-five horse power. The boiler is very simple and efficient; it will not explode if through inadvertence of the man in charge it is allowed to run short of water while a fire is burning under it, and the time of replacing a tube, should one be burnt, is but a few minutes. The boiler gives a working pressure of 100lbs. to the square inch in from eight to ten minutes after lighting the fire, so that steam can be got up nearly as quickly as the hoses can be laid and the tools can be got in readiness. The steam and water cylinders of the engine are not attached to the boiler, they are horizontal and direct acting, and, being fixed on a strong wrought-iron framing, they are very rigid. The stroke of the piston is long, and worked at a moderate speed, and, consequently, the wear and tear is reduced to a minimum, while an excessive speed is not required to deliver a maximum amount of water. The valve motion is extremely simple, and enables the engine to run at any required speed. As already stated, the engine is capable of throwing 300 gallons per minute, but it is so regulated that it can be made to throw only one gallon per minute if so required, and of course any intermediate quantity. The pump is simple, direct, and double-acting, made in one solid gun-metal casting, and has perfectly reliable valves with gun-metal back-plates. The opening of each valve is quite clear, without bars or grating, so that it will pass anything that will come up the suction-way; gravel, straw, shavings, rags, &c., will never choke it on account of the largeness of the valves. The pump is also frost-proof. The pistons being small, there is a minimum of friction, they are also self-lubricating, and require no oiling when at work. Both suction and delivery ways are fitted with

capacious copper air-vessels, and there is a simple apparatus connected to the delivery air-vessel which keeps up a constant supply of air, enabling the pump to throw a compact and steady jet. On account of the extraordinary simplicity of this kind of engine it has been found to render the most satisfactory service in untrained hands. I have made similar machines, differing only as to size, for many English mansions; I recollect supplying them amongst others to the Duke of Norfolk for Arundel Castle, the Marquis of Exeter for Burghley House, the Earl of Shrewsbury and Talbot for Ingestre Hall, the Earl of Jersey for Middleton Hall, the Earl of Dartmouth for Patshull House, the Earl of Rosebery for Mentmor, the Earl of Pembroke for Wilton House, Lord Francis Cecil for Stocken Hall, Lord Leconfield for Petworth Park, Lord Ilchester for Melbury Park, Colonel Tomline for Orwell Park, Colonel Owen Williams for Temple House, Colonel Joicey for Newton Hall, John Lancaster, Esq., for Belton Grange, F. Bassett, Esq., for Tehidy Park, W. O. Foster, Esq., for Apley Park, and to many other noblemen and gentlemen in England and abroad, especially in India, where many of the native princes have adopted these machines.

Steam fire engines are very useful upon an estate, for purposes other than that of fire extinction. They can be employed in any kind of pumping or irrigation work, and are therefore valuable auxiliaries in case of stoppage or break down of the regular pumping machinery. At the Marquis of Exeter's the steam fire engine is largely used for irrigation purposes. They have been employed occasionally in supplying water to towns and districts where disputes have arisen with the water company, and have then worked night and day continuously for many months. Some years ago my engines were working in this way for a long time at Richmond (Surrey), and later still at Caterham, where they pumped through some miles of iron pipes to Kenley; and during the Siege of Paris in 1870, a number of them, sent into the City by the last train which entered it before communication was cut off, were employed in

supplying the inhabitants with water for drinking and culinary purposes, as well as for extinguishing fires during the bombardment.

These engines are intended to be drawn by a couple of horses, and they have accommodation for the driver and seats for men; they are therefore available for travelling long distances.

Many estate owners allow their men not only to proceed to fires on the estate, but to render assistance at fires in the neighbourhood. This is to be recommended to keep the men in practice, and to give them a little experience which may some day be valuable at home. But arrangements should always be made, so that the mansion is not left unprotected in case of accident arising during their absence. Neither the whole of the men or apparatus should be allowed to be away at one time.

Manual fire engines—The London brigade manual.

The most efficient hand worked fire engine is that known as the London brigade pattern. Like the steam fire engine it is fitted for horse draught, and has a seat for the driver, accommodation for men to ride upon it, and stowage room for the suction and delivery hoses and all the working tools. It is, therefore, equally adapted for travelling to distant parts of the estate for the protection of the home and outlying farms. This kind of engine is made in eight or nine sizes, the largest being capable of pumping 220 gallons of water to a height of 150 feet; it requires 46 men to work it at its full power, but as so many will scarcely ever be available for the work upon a gentleman's estate, I may set it down as too large for the protection of private residences. The engine of this class, usually found at mansions, throws 115 gallons to a height of 125 feet when worked by 26 men; its cost, with a full complement of hose and tools, is from £180 to £200, or about half the cost of a small size steam fire engine. The London brigade manual is arranged to take its suction either from a reservoir, lake or hydrant, or from its own cistern, which has then to be filled by means of buckets. I have several times seen these engines

working at a considerable distance from the water supply ; they were served by buckets passed from hand to hand along a line of people formed from the engine to the water, the empty buckets being returned to the water along another line. Occasionally, when there are two or more engines, and but a few people present, one engine stationed at the water has been made to pump into the cistern of another, placed as close as possible to the fire. Engines of this class are to be found at Osborne and Sandringham and at the mansions of the following, amongst many other noblemen and gentlemen—the Dukes of Buccleuch and Portland, the Marquises of Hastings and Downshire, the Marchioness of Londonderry, the Earls of Burlington, Carnarvon, Crawford, Derby, Faversham, Hardwicke, Leicester and Somers, Lords Bolton, Bradford, Calthorpe, Darnley, Ilchester, Lathom, Northwick and Tredegar, Baroness Willoughby d'Eresby, and Countess de Morella. There are 87 of these engines now in the London Fire Brigade.

The mansion fire engine.

The mansion fire engine is constructed upon the same principle as that mentioned above, but it has smaller wheels, and is without the horse pole, seat and arrangements for horse draught. It is not intended to be taken far away from the house, but there is a hand draught pole, by which it can be pulled by two or three men. The power of the larger engines is similar to that of the London brigade manuals, but very small engines of the class are also made ; the smallest is worked by six men, and throws 45 gallons per minute to a height of 80 feet under favourable conditions. The capacity of the engine usually adopted is 85 gallons per minute, 110 feet high, when worked by 16 men.

Manual engines of 20 men power and upwards will throw two good streams, and three or four very useful jets ; but as a rule they should not have more than two lines of hose attached. There are many other kinds of hand-worked engines, made to suit special requirements, but I do not intend to add particulars of these. A statement of the conditions it is desirable to fulfil will always enable a fire engine maker to send what is best for the purpose.

CHAPTER VI.

WELL PROTECTED MANSIONS.

FARNBOROUGH HOUSE—RAGLEY HALL—EASTNOR CASTLE—SANDRINGHAM HALL—BURGHLEY HOUSE, STAMFORD—KNOWSLEY—MONTAGU HOUSE, WHITEHALL—ARUNDEL CASTLE—WILTON HOUSE—PATSHULL HALL, ALBRIGHTON—BLENHEIM PALACE—EATON HALL—CLUMBER HOUSE—WARWICK CASTLE—HATFIELD HOUSE—HAMPTON COURT PALACE; STEAM FIRE ENGINE AND WATER SUPPLY; THE PALACE FIRE BRIGADE.

I HAVE stated that country residences, as a rule, are not well protected from fire. But there are numerous instances where exactly the opposite is true, and I have thought it advisable, having described in detail the water supply and apparatus, which together with the human agency referred to in the succeeding chapter go to make up a complete system of fire protection, to furnish accounts of the manner these have been combined for the safety of a few of the largest mansions. In making my selection, I have necessarily been governed by this consideration chiefly; the extent of my own knowledge of the arrangements obtaining in these mansions; with reference to nearly all of those I mention I have been personally consulted, and for the most part the arrangements were adopted at my recommendation, and were fitted up under my own supervision.

Farnborough House.

The new residence of H.I.M. the Empress Eugenie has been fitted up with apparatus for dealing with fires of the most modern and improved type. In the new block of the mansion four galvanised wrought iron tanks have been fixed upon iron joists in the upper part of the staircase tower. All four tanks are connected and have a combined capacity of about 6,000

gallons of water, which is pumped up by means of a Turbine water mill, and the arrangement is such as to ensure the tanks being continually full. Thence 3-in., 2½-in., and 2-in. wrought iron distributing mains are carried to various points of the mansion, and mounted with eight fire hydrant valves inside the mansion and seven additional hydrants outside the building. Each hydrant is furnished with a length of patent rubber-lined canvas waterproof hose and a nozzle, so fitted that the person directing the stream of water may at any moment shut off the supply.

Some four dozen leather fire buckets, beautifully emblazoned with the Imperial Crown, have been hung in sets of four throughout the mansion and stables, while a portable hand fire engine, mounted upon wheels, stands upon each floor, always full of water, for instant use upon the discovery of a fire.

On the second floor of the old portion of the mansion two tanks of a capacity of 3,500 gallons are in connexion with a platform fire engine and 220-ft. of hose and fittings. This engine is so arranged that in the event of a fire occurring upon the lower floors no pumping will be necessary, as the water will pass through the engine with good force, but when one, two, or more persons are at hand to work the engine the force will be so augmented that the stream would reach the height of 70-feet above the nozzle; and the whole of the hose fitting universally enables the engine to be of service for the new as well as the old wings of the building.

Mention should not be omitted of the hand hatchets, which hang in leather sheaths along with the buckets, for use to cut away or remove fixtures, flooring boards, &c. In addition to these arrangements a reservoir of some 12,000 gallons capacity has been built under the ground at the west end of the mansion, to pump from which a patent single cylinder steam fire engine has been provided. This engine will stand in the glass roofed entrance court of the mansion. It weighs about 20 cwt. and will raise steam from cold water within eight

minutes after the ignition of the fire and pump some 300 gallons a minute, in either 1, 2, 3, or 4 jets, to a height greater than that of the mansion, and it stands completely equipped with suction and delivery hose and all necessary fittings.

At an experimental trial steam was raised in the boiler to 100lbs. pressure within 8½ minutes of lighting the fire, and supply being taken from a fish pond, a stream directed to a great altitude through a ¾-inch nozzle, after which a ⅝ and a ¾ stream were directed simultaneously through two long lines of hose.

The engine was then driven back to the mansion, and a trial made by pumping from the 12,000 gallon underground reservoir, which has been specially constructed for the engine's supply. From this point three powerful streams were thrown at one time, and a jet from a ⅞-inch diameter nozzle passed high above the turret surmounting the highest portion of the mansion.

It is intended to construct a second reservoir in front of the mansion, of the same capacity as that from which the engine was worked at the rear of the mansion upon the occasion in question.

Ragley Hall.

Ragley Hall, the seat of the Marquis of Hertford, is situated upon high ground, commanding an extensive view of a deer-park studded with majestic oaks, and noted covers.

The appliances for the protection of the buildings on the estate include a somewhat early specimen of the manual fire engine, known as the "Bedposter," made by the firm of Hadley, Simpkin, and Lott, of London. A more modern machine is the curricle fire engine. It is worked by six men, who will pump 50 gallons per minute, and throw the jet to a height of 70 feet. Both engines will work together, as the gear is interchangeable, and thus a double effect can be produced. Several yards away from the foundations of the Hall, and upon the east, north, and south sides, are situated large underground reservoirs, to supply the manual engines.

These reservoirs not only collect the rain-water from the roofs of the Hall, but are partly filled from the overflow of the cisterns or tanks for the supply of water required for the usual domestic purposes. This supply is raised from the lake by self-acting rams, which are at a considerably lower level, and at a distance of half-a-mile from the Hall. The water is firstly delivered into these tanks, from which the overflow returns to the underground reservoirs. The overhead tanks are erected at the four corners, whilst two large tanks have recently been added and erected near the centre of the building ; these are kept solely for fire purposes, and are always full of water. The tank system has been connected throughout, so that the whole supply is available from one or other of the vertical mains which descend to the basement. The "Langham" pattern fire cocks are conveniently arranged to command the different floors, with a plentiful supply of buckets and hand pumps on the bedroom floors and near to the servants' apartments. The value of these hand engines was, in the early part of this year, fully appreciated by his late lordship's eldest son, the present marquis, who resided about three miles from Ragley. He had been making extensive alterations and additions to his mansion, and expected to have occupied the new buildings on the day following. Unfortunately, by some cause or another, the new portion caught fire and was burnt to the ground, and had it not been for the effective and powerful little hand engines, one of which was worked by his lordship, the other portion of the building would certainly have been burnt, and probably it would have extended to the coach-houses, stables, and outside premises, clearing off the whole of the offices. After this fire, the late Marquis of Hertford issued the following "Precautions against Fire," printed on cards, hung conspicuously throughout the Hall, and adjoining each fire station :—

Precautions against Fire.

1.—Be cautious how you use matches and candles. See that they are quite extinguished before leaving a room.

2.—Mind that the wind does not blow a curtain over a gaslight or candle.

3.—Do not leave any paper, shavings, rags, &c., where a fire or candle could possibly set them alight.

4.—Report any unusual smoke, or smell of fire, to the Butler or Housekeeper.

In Case of Fire.

1.—Don't be frightened, but think calmly and quickly what is best to be done, recollecting that time is everything, and that a man's cap or a jug of water, applied promptly, or a curtain pulled down and stamped upon vigorously, may save a serious fire.

2.—If this is insufficient, run and get help, closing the doors and windows as you go, and fetch the nearest hand pump, or extinctor, and apply it immediately.

3.—Maidservants cannot manage the hydrants or hose, but they can fill the fire buckets and cans, and pass them from one to another in line without confusion.

4.—If in the night, ring the house-bell and call up everyone, sending at once to the bailiff, the head gardener, head carpenter, the odd man, gas man, &c.

5.—A groom on horseback should be sent to those living in the village, and who should then go on for the engine and the police.

6.—The gas man, assisted by the stablemen, to take the fire engine from the coach-house to the nearest point where there is water, and attach the hose, nozzle, &c.

7.—The hydrants and hose in mansion should be got ready, but not let go without necessity, for fear of doing damage by water as well as by fire.

8.—The engines (at the lake) to be set at work, to keep the cisterns as full as possible.

9.—The odd men will get ladders, and always have saws and axes and a long rope for hauling the hose up, &c. Ladders always to be kept in the same place (viz., near the old brewery) after use, so that all may know where to find them.

MEM.—If smoke is thick, cover your mouth and nose with a wet silk handkerchief, sponge, worsted stocking or flannel, and crawl on your knees. If your clothes catch fire, throw yourself down instantly on a rug, or thick shawl, or counterpane, and roll yourself in it.

N.B.—There will be periodical trials of hose, engines, &c., at which everybody is requested to assist regularly upon the first Wednesday in each month.

HERTFORD.

Eastnor Castle.

Eastnor Castle, Ledbury, the seat of Lord Somers, was built in 1815 by the grandfather of the late Earl Somers; it is in the Norman style, and is justly celebrated for its beauty, both of architecture and position. It is well supplied with water; in the grounds there is a large lake, and a gravitation supply has been lately completed for fire purposes. There is a large underground reservoir, capable of holding 25,000 gallons, which receives a constant supply from a spring at the foot of the Malvern Hills, about three miles distant. The elevated ground upon which the reservoir is built is 300 yards from the Castle; from the reservoir a 4-inch high pressure main surrounds the exterior of the Castle, and supplies seven fire hydrants, from any of which a deluge of water can be thrown in case of necessity. For the protection of the interior a junction has been made with this outside main, and a 3-inch branch carried below the ground level into the basement, thence wrought-iron 2½-inch branches are taken to various positions, so as to protect the hall, library, drawing rooms,

boudoirs, &c. The fire valves are of the well-known Langham Hotel pattern, and each is provided with lengths of water-proof hose and the usual fittings. The Castle has also an excellent supply of London Fire Brigade pattern pumps and leather buckets.

In order to utilise the water in the lakes for fire purposes, a manual fire engine of the "Paxton" type has been acquired; it is similar to the engines used in London, and by fire brigades throughout the world. There are facilities for carrying upon the engine all the hose, suctions and tools for working it, and it is arranged to be drawn either by men or horses as occasion requires. A fire brigade has been formed amongst the men employed upon the estate; the engine is examined, and the men taken out for drill, I believe, upon the first Monday in every month; the members of the brigade usually practice for two hours upon every drill day, during which time they go through all the different evolutions, so that each member is thoroughly well up in every part of the work. Upon a recent practice a jet was thrown over the flagstaff tower, the engine being stationed at the lake, and worked by twenty men; the water was pumped to a total distance of 377 feet, and to a height of 137 feet. About 300 feet of hose are carried upon the engine, in addition to special appliances for use at stack yard and other farm fires.

Sandringham Hall.

The Prince of Wales, being no mean fireman himself, has taken care that nothing shall be wanting on his Norfolk estate for the protection, not only of the Hall, but also of his tenants, by whom his Royal Highness is regarded not only with the respect due to a future monarch, but also with the warmer regard which a generous and genial landlord always inspires. The Prince selected a manual power fire engine of the London pattern, and when it was taken to Sandringham I had the honour of personally drilling his Royal Highness. This type of engine is now popularly known as the 6-inch London Brigade Manual, extensively adopted by the Metropolitan Fire Brigade,

for use in suburban districts, on account of its lightness, the facility with which it may be run by a few men on level roads, or be drawn by one or two horses where there are hills. At the periodical tests, which are held very frequently, it has repeatedly shown what it could do on an emergency, having pumped over the house through as much as 700 feet of hose. The engine is kept in an engine house, the doors of which are always open, and a fireman is always in attendance. Throughout, the mansion is well supplied with fire pumps and buckets. Inside the Hall hydrants are placed on each staircase, with the necessary provision of branch pipes and hose, buckets, &c.

Burghley House, Stamford.

The Marquis of Exeter's residence at Stamford has a fine external supply of water. There is a broad sheet situated upon the sloping lawn on the south side, and on the north the ground slopes towards the river Welland. A steam fire engine of great power has been provided, and there is also a hand engine, both of which are kept in a building close to the mansion, and especial attention is given to their being ready for immediate use at any moment. A private fire brigade has been formed, and it is now quite an institution; the members are drilled periodically, the Marquis and Lord Burghley taking great interest in this department of the household. There are also various small portable appliances within the building placed in the corridors and passages.

Knowsley.

This magnificent seat of the Derby family, with its noble apartments, containing amongst other treasures invaluable paintings by Rubens and Rembrandt, is well protected from fire. In the park there is an inexhaustible supply of water, contained in a lake more than a mile in length, and a powerful steam fire engine has been acquired, so that it may be employed to the greatest advantage. There is also a most complete system of outdoor and indoor hydrants, with all the

requisite apparatus, fitted up under the personal superintendence of my late brother, Mr. Richard Merryweather, who, I recollect, took especial interest in the fire arrangements of this mansion.

Montagu House, Whitehall.

This is an instance of a large town mansion admirably protected from fire. Montagu House belongs to His Grace the Duke of Buccleuch; a conspicuous part of the mansion is the Mansard roofs. Each of these roofs contains a large cast-iron tank holding some hundreds of tons of water; they are supplied by a 4-inch rising main attached to the water company's high pressure service, and are, of course, always kept full. To ensure the tanks being charged, there is fixed in the steward's office an indicator with a clock face, so that the steward must necessarily be aware of the fact should the water for any purpose have been drawn off. From each of the tanks two downright mains are carried, having polished gunmetal hydrants neatly secured in recesses of the walls; these hydrants are placed in convenient positions throughout the building, and for each there is a full complement of leather hose, branch pipes, and the necessary fittings. The servants are well instructed in the use of the apparatus.

Blenheim Palace.

The following particulars relating to Blenheim Palace, Woodstock, the residence of his Grace the Duke of Marlborough, have been obligingly furnished by the Clerk of Works on the Estate:—

The water supply is taken from the rivers Glyme and Dorn, which rise from springs out of the limestone rocks, and passing through the valleys, each receive various small streams before they join in one stream about three miles above Woodstock. From that point the river takes a very crooked and tortuous course through the flat marshy meadows to Woodstock, where it enters Blenheim Park; it then expands into a grand and noble lake of nearly 300 acres in extent, formed in the valleys in the park.

The water supply and the means for extinguishing fires at Blenheim Palace were very defective indeed till the year 1861. The palace, and also the town of Woodstock, was supplied by one set of treble pumps driven by water from the river Glyme just before it enters the lake in the park, through a 4-inch iron main to a tank formed between the parapets over the porter's lodge, and lined with lead, which held about 20,000 gallons. From this tank it was conveyed into the basement through a $2\frac{1}{2}$-inch lead pipe, and carried to the various departments of the household as required. In the year 1861 a fire broke out in a room adjoining the Titian Picture Gallery, destroying the room and several pictures, which were considered of great value. This caused the late Duke to put his house in order, and provide means for extinguishing fire in any part of the building; he put in another set of treble pumps at the mill, and five rams at the bottom of the lake below the cascade, and constructed a reservoir on the highest ground in the park to hold fifteen million gallons; he also laid down a 10-inch iron main pipe from the reservoir to the south-west angle of the palace; from this point there is a 4-inch iron main carried up the centre of the staircases in the south-west and south-east angles of the building. The water flows by gravitation from the reservoir through the mains before mentioned to the top of the palace, where suitable tanks are provided for the use of the house. There are fire hydrants provided in the main pipes at every landing, and a sufficient length of leather hose attached to reach to any room, or any part on the top of the building; one great advantage is, should a fire occur at one end and render it impossible to get at the pipes, by lengthening the hose it can be played upon from the other. There are several places on both sides of the house where the 4-inch main is carried for fixing stand pipes so that any part can be played upon from the ground.

There is also one of Merryweather's powerful manual fire engines kept at the palace, and a fire brigade, composed of the house servants and gardeners, and they exercise with the

engine. The arrangements are all tried once every month, so that everything is kept in working order.

In 1880 the late Duke had another reservoir made nearly half an acre in extent, so that there is a great quantity of water ready at any moment for the purpose of reaching a fire.

There is a policeman always patrolling round the building every night, so that if anything should break out he would give the alarm at once, and the men servants, who are thoroughly acquainted with fire brigade drill, could be at the spot directly, before any serious damage could be done.

Eaton Hall.

The water supply to Eaton Hall, the residence of his Grace the Duke of Westminster, is furnished by the Wrexham Water Works Company, by 5-inch pipes from their reservoir near Wrexham. There is also an additional supply from the River Dee, about 500 yards from the house, which is drawn up through a 5-inch main by a steam engine of 20 horse power.

A supply is kept in tanks at the top of the chapel and library towers, which contain many thousand gallons.

The house has hydrants both outside (all round) and in the staircases and passages inside, also hydrants on the roof. A large hand fire engine is kept on the premises, and there are extincteurs and small hand engines inside. Fire escapes are also at hand in the upper rooms. The men comprising the fire brigade practice every month under the superintendence of Lieut.-Col. Scotland, and are thoroughly efficient.

Clumber House.

The water supply of Clumber House, Worksop, the residence of his Grace the Duke of Newcastle, is obtained from a well, situate about 350 yards from the house, and is pumped by a turbine driven by a 4 ft. fall of water close to the well. The water is forced through a 5-inch main pipe to a reservoir, about 400 yards from the house. The reservoir is seventy feet above the ground floor level of the house, and gives a pressure of about 30 lbs. to the square inch. In connexion with this reservoir there are five 3-inch rising mains to the top of the

house, one hydrant being fixed on the basement floor, five on the ground floor, four on the mezzanine floor, five on the first floor, and five on the roof; from the ground the water can be thrown to the top of the house, which is about 50 feet high.

In connexion with these twenty hydrants two thousand one hundred feet of leather hose pipe have been provided; the necessary tools are fixed close to each hydrant, on an ornamental board with a length of hose, a jet, and key to turn on the water when wanted, and the workmen practice the use of these pipes and hydrants once a month. The reservoir will hold about 66,000 gallons of water, and the turbine can be kept continually working. The water is good, bright, and clear, and is used for domestic purposes.

Warwick Castle.

Warwick Castle takes its water from the town of Warwick, which is supplied by gravitation. The water is drawn from springs in a deep bed of sand four miles off. A 5-inch main is laid to the castle from the 12-inch main which supplies the town. There are hydrants both inside and outside the castle at all the important points, and standpipes and hose are kept ready at each of them.

The pressure on the main is such that water can be thrown on to the roof of the castle from the court yard without the aid of any fire engine. The supply is a constant one.

Hatfield House.

Hatfield House, the residence of the Marquis of Salisbury. The house is fitted with a 2-inch main throughout, with hydrants fixed at all convenient points; the water is supplied by gravitation from a large reservoir in the park, the 4-inch mains from which are continued round the house and hydrants fixed on all sides. A second 4-inch main is laid from a pond supplied by a spring in the park at a lower level than the reservoirs. This is also fitted with hydrants, which throw the water by the force of gravitation to the first floor level. Two large tanks are erected in the turrets, and force pumps are fixed by them, so that water can be forced over the clock tower.

Water can also be obtained by pumping direct from the river, one and a-half miles away, on the top of the house from turbine and treble barrel pumps. The large reservoir in the park is also supplied from this source; other ponds are supplied by springs from which water can be drawn to the low service.

In fact a water supply of eight to ten million gallons is always at command at a moment's notice, and every appliance for bringing it into effective service is provided.

Hampton Court Palace.

Hampton Court Palace has a most excellent water supply and fire equipment, special measures having been taken in 1880 for their improvement. Before this date the water supply was obtained from a reservoir or catch-water some three miles off, the water flowing by gravitation, and the pressure, which was not very great, being that due to the head of water at the reservoir. In order to improve this condition of matters, Mr. Lessels, of Her Majesty's Office of Works, designed a more efficient arrangement. A handsome engine-house has been built of brick, with stone facings, the design and appearance being more or less in keeping with the palace buildings. In this house is fixed a powerful, quick-raising steam fire engine, which was supplied by Messrs. Merryweather and Sons, and which in construction and power is similar to those used by the Admiralty and the Russian and French Governments for naval purposes. The water for the supply of the engine is still taken from the reservoir, and is delivered through a 10-inch pipe into a deep well. Besides this, a 12-inch pipe has been laid down from a canal in the palace gardens, the water of which can also be delivered into the well. If one source should fail, the other can be tapped, so that there is an ample supply of water always at command. The water is pumped by the engine from the well and through 10-inch cast-iron mains, which are laid, with branches, about the grounds of the palace. To the branches hydrants are attached at convenient intervals, and by attaching a hose to the hydrants the full force of the water can

be available at any point and at any time. At the official trials, although, through the severe frost, the water was frozen in the boiler, steam was generated in four minutes from the fire being lighted, and in ten minutes a working pressure of 100lbs. per square inch was reached. The large fountains are supplied from the main which brings the water from the reservoir, and these were first started, the engine throwing the 200 jets of water of which they are composed to a height of about 60 feet, or double the ordinary altitude. Water was next discharged through two large fire nozzles fixed on hose attached to hydrants 300 feet from the engine-house, the water being projected across the basins. After that, several jets were thrown over the Great Hall with good effect, and with such power that the authorities stopped the experiment, as it was feared the force of water might endanger the stability of the old stone pinnacles. A spray nozzle was then tried, which caused the water to be thrown in a gentle stream, such as it would be desirable to use for the protection of pictures, tapestry, and furniture from fire. A private brigade was formed out of the palace employes, under the very able superintendence of Mr. Moorman; this department of the household being placed under the charge of Mr. Chart, clerk of works. The members of the brigade were thoroughly trained, drills were undertaken at short intervals, and in a very few months the brigade was thoroughly efficient. In December, 1882, a serious outbreak of fire occurred, and the palace was saved, the men and means being at hand; I shall insert an account of this fire in its proper place.

Arundel Castle.

The fire extinguishing arrangements at Arundel Castle are as follows :—In the first place there is a steam fire engine, capable of throwing upwards of 300 gallons per minute, and always ready at a moment's notice; in addition to this is a manual engine, and about a dozen hydrants with hose attached, in the different parts of the interior of the castle. Within a short distance of the castle is a large lake, from which the

water supply is derived ; adjoining the lake is the engine-house, containing a large water wheel and two pumping engines, the latter being worked by the water wheel, with surplus water from the lake. The water is forced through a five-inch rising main to a height of about 150 feet into a large storage tank, which is called the fire tank, and which contains 400,000 gallons ; an overflow pipe from this supplies a second tank containing 200,000 gallons more, which supplies the castle and various hydrants in the town with water for domestic purposes. These tanks are situated about a quarter of a mile from the Castle, and are at a sufficient elevation to carry the water by gravita tion to some fifteen feet or so above the castle roof. The water is conveyed from the tanks to the castle by two cast iron mains, a four-inch for the domestic supply and a five-inch for the exclusive supply of the steam fire engine ; both mains, how ever, are available in case of fire.

Wilton House, the seat of the Earl of Pembroke. Part of the previous mansion being destroyed by fire in 1648, it was rebuilt in its present form by Inigo Jones. It is situated near the junction of the rivers Nadder and Wiley, and thus having a plentiful supply of water in close proximity, reliance is largely placed upon fire engines working externally. Wilton House.

The water is pumped up from the Nadder by means of three throw pumps, driven by an excellent vertical steam engine, the steam for the purpose being taken from the same boiler that supplies the engine for the saw mills. From the pumps a three-inch supply joins a five-inch main, about midway be-tween the mansion and the reservoir. The reservoir is built on the top of a hill in the Deer Park, and contains about 60,000 gallons. It is made of concrete and covered in.

From the reservoir the five-inch main is led direct into an old three-inch main, laid round the house, originally from the Town Waterworks of Wilton (an intermittent supply) ; on this main round the house and offices on the outside are eleven hydrants, and a two-inch branch is taken off at the four corners

of the house, and a standpipe with fire cocks on each floor, carried up in each of the four towers, with leather hose in the basement and canvas above, one hydrant is situated in the centre of the quadrangle, and from this a branch is taken to supply a fire cock fixed in the upper cloisters for the immediate protection of the state drawing-rooms, containing most valuable paintings. Last year the whole of the fire arrangements were overhauled ; two new hydrants were placed in the long passage immediately opposite the kitchen and laundry doors, which previously were somewhat unprotected. In addition to this the external fire department was re-organised, three or four old useless manuals were done away with, one comparatively new manual only being retained ; and a steam fire engine, with 520 feet of hose added to the previous stock, new unions being put to old hose and manual engine to make it interchangeable. In the engine-house, immediately inside the lodge gates, are kept the standpipes for outside hydrants. The internal arrangements are in the charge of the house steward, who periodically drills the men inside ; the steam fire engine and the outside hydrants are under charge of the clerk of works, assisted by twelve of the estate workmen from the Fire Brigade, who are drilled periodically, and are ready to attend any fire in the neighbourhood.

Besides these there is one hydrant at the saw mills, and one taken off the three-inch supply, as it passes the house and premises of the head gamekeeper. In the opposite direction from that of the main to the house, a three-inch main takes the water across the park to the Home Farm and kennels. Supplying both places at the farm are two hydrants with standpipe and hose, and one hydrant at the kennels. The hydrant at the Home Farm has been the means of saving the building, a fire breaking out there late one night in 1882, which could not possibly have been extinguished if the hydrant had not been there.

Patshull Hall, the residence of the Earl of Dartmouth, obtains its water supply from a perennial spring in what was formerly an old quarry, in the red sandstone. From the quarry it is pumped by three hydraulic rams into a long brick-built reservoir on the side of the hill, forming what is known as the "High Park." The reservoir is situated at a point considerably higher than the Hall, to which the water descends by gravitation in four-inch cast iron pipes ; the distance is about a mile and a half. This is the principal supply, and it has been recently constructed. The old supply is from a splendid spring of very pure and good water, situate at a farm and at a lower level than the reservoir just mentioned. The water comes to the Hall from this spring direct through two-inch lead pipes ; the distance of the spring from the Hall is also about a mile and a half. I noticed that the lead pipe is cast ; every three feet of it bears the inscription :— Patshull Hall, Albrighton.

RICHD. IAMES BRIDGNORTH,

PLUMMER, 1738.

The greater portion is as sound as it was when first laid down ; the only part that has had to be taken up was where the pipe lay in the bottom of the "Great Pool," which it crosses ; this had to be renewed a few years ago.

Inside the mansion there are fire mains running up the principal and secondary staircases, with fire cocks conveniently placed ; these mains both extend up to and through the roof, where hose can also be attached. The mains are connected with the principal water supply from the reservoir at High Park. So are the firemains which quite surround the mansion outside, and to which the proper hydrants are fitted. A powerful steam fire engine has been acquired, which my man inspects and overhauls periodically ; there is also a dog-cart engine to be worked by hand, and a hand engine which can either be mounted on a four-whee carriage provided for the purpose, or carried into the building. In addition to these the mansion is well fitted up throughout with hand fire-pumps of

various sizes, buckets, and other portable appliances. I believe it is intended to still further provide for the safety of the mansion by securing another and larger supply of water, to be pumped by steam power ; a reservoir for storage is now being constructed which will hold nearly half-a-million gallons, and this practically inexhaustible supply will be brought by four-inch pipes to the Hall, where it will probably be taken into the fountain basins as well as into the fire mains which surround the structure.

CHAPTER VII.

MANSION FIRE BRIGADES.

FIRE APPLIANCES NOT AUTOMATIC—PERIODICAL DRILLS—THE HOUSEHOLD BRIGADE — EXAMPLES OF PRIVATE FIRE BRIGADES—DRILL MANUAL—PERIODICAL INSPECTION BY THE FIRE APPARATUS MANUFACTURER—REGULATIONS FOR THE CARE AND WORKING OF APPARATUS — GENERAL RULES TO BE OBSERVED IN THE EVENT OF FIRE—INSTRUCTIONS FOR USING THE HAND FIRE PUMP — INSTRUCTIONS FOR USING THE CHEMICAL ENGINE—DANEBURY FIRE BRIGADE RULES.

Fire appliances not automatic.

THERE is no virtue in the mere possession of fire extinguishing appliances. They are useless unless they are in order at the time of the outbreak, and, not being automatic, unless also arrangements have been previously made to ensure their being promptly and intelligently brought into action. Having provided a good, efficient, and complete system of fire extinguishing apparatus, it is of the utmost importance to see that it is maintained in such a condition as to be always ready for use. I need not say that fire always breaks out when and where it is not expected. Most fires happen late in the evening or during the night, and naturally upon an alarm being raised the immediate feeling is one of panic. The servants, if they encounter difficulty in their first efforts to bring the appliances into use, are easily disheartened, and infected with the prevailing fright. Therefore every part of the machinery provided for fire extinguishing should be known by the person in whose charge it is to be perfectly ready for use at all times.

Periodical drills.

In order to maintain this desirable condition of affairs nothing is more effective than frequent periodical drills by the resident fire brigade.

The servants whose duty it would be to work the appliances should be exercised at least once a month in their manipulation by the steward, butler, or other servant who has been constituted the head of the "household brigade." This will ensure everything being in its place and in good order; the drill would be as effective as a real fire in bringing to light any hidden negligence or accident. Fire drill is as easy and simple as a drill of any sort can possibly be, and an hour's practice every month should make every servant proficient.

The household brigade.

A certain number of the male servants would of course be told off to form the household brigade proper, and each member should have some particular duty assigned to him in case of actual fire, that of the superintendent being to see that no man is absent from any cause, or that if absent his place is supplied by another, and that the best possible water supply is available. The rest of the servants would be supernumeraries, but all should learn the drill, which should consist of the bringing into use, in one way or another, of all the apparatus upon the estate. If there is a steam fire engine steam should be got up, the hoses attached, and water passed through them; the machine should then be thoroughly looked over to see that nothing is missing or out of order. A manual engine should also be tried by actual use. It is a very good plan to offer small rewards to the man who can get the fire engine ready for work in the shortest time at these practices. All the hoses and tools being in their places upon the engine, they should be attached to the machine in the proper manner for duty as rapidly as possible, the quickest man, if his work is properly done, obtaining the prize. The hydrants inside the mansion should also be examined thoroughly, especially if it is not possible to test them periodically by allowing water to pass through the hoses. The hand pumps and chemical fire extincteurs should be worked, the latter being recharged carefully before putting away. Any defects in the apparatus should be immediately reported, and remedied without delay.

Private fire brigades, such as we have described above, have been most successfully inaugurated by many noblemen and gentlemen. I recollect particularly that at Sandringham House (H.R.H. the Prince of Wales), which I have myself drilled, at the Duke of Westminster's place at Cliveden, at Burghley House, the seat of the Marquis of Exeter, at Elton near Peterborough (the Earl of Carysfort), at Belton near Grantham (Earl Brownlow's), at Northwick Park, Moreton-in-Marsh (Lord Northwick), and at Petworth Park (Lord Leconfield's). At the latter especially a most efficient brigade has been established; it not only protects the mansion and the rest of his lordship's property, but the whole district, the Petworth Park Brigade being almost invariably the first to arrive at any local blaze. A good system of drill is a valuable aid to captains of private brigades. I can recommend a very excellent manual of drills, some (but not all) of which are applicable to private brigades. It is the work of an official connected with the Stourbridge Fire Brigade, and is published at the *Fireman* Office, at 2, Grocers' Hall Court, London.

Examples of private fire brigades.

Drill manual.

The best check against that negligence and want of caution on the part even of our private brigade which long immunity from disaster may occasion, I hold to be a periodical inspection and drill by some person not connected with the estate; preferentially by the fire engineer by whom the appliances were made. Twice a year will probably be sufficient to keep the servants well up to their duty. He should go most minutely over the fire gear, and make himself personally acquainted with every man who is to handle it, and, after every such inspection, a written report should be furnished to the owner direct, or to the agent of the estate. The expense of these half-yearly visits is infinitesimal, their value on the other hand is very great; they ensure the maintenance of the whole machinery in its first condition and prevent the annoyance which must be felt if good and expensive apparatus should fail because, after years of idleness, it is found wanting in some small but essential particular when the necessity for its

Periodical inspection by the fire apparatus manufacturer.

use arises. The well known surveyor of Canterbury Cathedral, Alderman H. G. Austin, wrote me a letter upon this subject some years ago; he says:—

"I much approve of the system of periodical inspection by one of your staff, and I commend it unhesitatingly to those who have fire apparatus of any kind, and who are too apt to leave their appliances to the perfunctory care of indifferent subordinates, or perhaps, oftener still, leave them without any overhauling whatever. The regular attendance of your representative, who is influenced by no considerations but those of doing his duty, acts as a moral check against the possible carelessness of men, and contributes to the maintenance of the machine in a condition of constant preparedness for action."

The Duke of Devonshire, Lord Leconfield, Lord Dartmouth and many other owners of large estates follow this plan, and have found it of great value.

Regulations for the care and working of apparatus.

For the guidance of the household brigade I append here a list of regulations for the care and working of various kinds of fire appliances. In every mansion it will be necessary to draw up a code adapted to the special circumstances of the case; its essentials will be found in those which follow. A very good set of rules drawn up by the late Marquis of Hertford will be found in Chapter VI. under the head of Ragley Hall.

A copy of any rules adopted should be in the possession of every member of the household brigade, who should be made to read and understand them. Cortachy Castle might easily have been saved last year had Lord Dudley's servants taken the trouble to acquaint themselves with the use of the fire apparatus which Lord Airlie's foresight had provided.

GENERAL RULES TO BE OBSERVED IN CASE OF FIRE.

General rules to be observed in the event of fire.

Should a fire occur, at once make for the fire valve nearest the seat of the outbreak, remove the cap (if screwed tight using the hose wrench), screw the female end of hose on the fire valve, and attach the copper branch pipe, with gun-metal

nozzle, to the male end of hose, turn on the water, and carry the branch pipe towards the fire, get as near the fire as possible, and direct the branch pipe so that the water may strike the burning material with force. Avoid twists and sharp turns on the hose.

Buckets should always be full of water, and may be used either to throw water on the fire, or to supply the hand pumps.

The fire appliances should have their proper stations, with which every person should be acquainted; they must be kept clean, in convenient order, and must not be displaced or used for any other purpose than fire.

Persons endangered should not stop to dress, but should wrap themselves in blankets, &c., and instantly seek the best means of escape; if the smoke be dense, they should place a worsted stocking or piece of flannel over the mouth and nostrils, and crawl on hands and knees.

If no better fire escape is provided, a rope of sufficient length to reach the ground should be kept in each room; this can be fastened to a bedstead, the bars of a fire grate, &c., and would afford means of escape.

All doors and windows should be closed, as they afford draught to the fire.

Should any fixture impede the extinction of the fire, immediately break or cut it away.

Coolness and presence of mind should be maintained as far as possible.

INSTRUCTIONS FOR USING THE HAND FIRE PUMP.

Instructions for using the hand fire pump.

1.—Keep the hand-pump always two-thirds full of water.

2.—Keep three or six buckets two-thirds full of water hanging close by the hand-pump.

3.—When a fire occurs, take the hand-pump as close to it as possible. Work the handle quickly up and down, and hold the hose to the seat of fire, when it will be readily extinguished.

4.—Keep up the supply of water to the hand pump from the buckets.

5.—Oil the leather hose and plunger occasionally with pure fish or neatfoot oil. Change the water once a week.

INSTRUCTIONS FOR USING THE CHEMICAL ENGINE.

Instructions for using the chemical engine.

To CHARGE.—Place the machine in an upright position and unscrew the cap.

Into the opening put the contents of one of the packets, and fill up with cold water until it runs through the cock.

Place a bottle mouth upwards, into the cage; remove the stopper and screw the cap into the machine. The extinctor should be placed on a pedestal about two feet high, and kept in this position until required for use.

To USE.—Invert the extinctor so that the screw cap will be underneath, and put the arms through the straps provided for the purpose.

Turn on the cock with the left hand and hold the nozzle with the right.

When the charge has been exhausted, the screw cap should be taken out and the empty bottle removed. Then proceed to charge, as above.

FIRE BRIGADE RULES.

Danebury fire brigade rules.

The following set of rules was drawn up by me during the time this book has been passing through the press, for the guidance of the servants at Mr. Tom Cannon's residence at Danebury; they may, perhaps, serve as a pattern for similar rules at other places :—

There are three sources from which water can be taken in the event of fire.

1.—The pond in the garden near the house.

2 and 3.—From the underground tanks in the stable yards.

On an alarm of fire being given, start the house well pumps at once, and run them as fast as possible to supply the pond.

Run out the fire engine to the source of water supply which is nearest the outbreak of fire.

Get the engine to work in the following manner: As soon as the engine is placed in position square the fore-carriage and secure it by placing the iron pin through the hole in the locking plate. Place in the water a length of suction which, with strainer and basket attached, is always kept screwed to the inlet of the fire engine. If the engine cannot be taken close to the water, so that a further quantity of suction hose is necessary, unscrew the strainer from the suction, screw on one of the suction hoses which are kept in the side pockets of the engine, and attach the strainer and basket to the further end of the length, see that the strainer is fast and kept well under the water, and that all the screws of the suction hose are thoroughly tightened up. Attach the delivery hose (which is carried on a reel) to the delivery outlet at the side of the fire engine and run quickly with the reel to the seat of the fire—the hose will uncoil as you proceed—connect the copper hand pipe to the end of the hose, and get as near to the fire as possible.

TO PUT OUT THE FIRE.

See that the water strikes the seat of the fire *directly*. Attack the fire from the *inside* of the premises if possible.

If the fire is spreading rapidly in more than one direction connect the V piece to the hose, which will enable you to use two streams instead of one. One stream should be thrown exactly upon the seat of the fire, and the second to prevent the fire from spreading.

The engine should be worked at the rate of 40 double strokes, once up and once down, per minute, and

8 men or boys should pump at *each* side. See that no sharp turns and twists occur in the delivery hose.

After the fire has been effectually extinguished, replace the appliances on the engine, and on returning it to its place ascertain if everything is sound, and pump the engine quite dry. If the engine has been pumping dirty water, pump a little clean through it. Thoroughly clean all the appliances and replace them in the engine in an orderly manner, ready for future service.

The pump barrels should be wiped out, and a quarter of a pint of prepared engine oil placed in each barrel (there is a can of this oil inside the engine hose-box, with instructions for its use).

The leather hose after use must be well rinsed in clear water, hung up by the middle to drain, and before quite dry brushed over with a thin coat of prepared hose oil, then tightly coiled up, the rivets being kept downwards ; if the rivets are dirty scrape them with a blunt knife provided for the purpose, and finish off with a piece of cardwire, which is kept with the other tools in the engine.

The hose must not be allowed to get dry and hard. If not used, it should be oiled at least three times a year.

If any damage has occurred to the engine, or any hose and gear has been burnt or lost at the fire, report it in writing to Mr. Cannon and to the instructor, who will see as to its replacement.

A drill will take place every quarter in presence of the instructor from Messrs. Merryweather and Sons.

I have not added any directions concerning the management of steam fire engines. There are several types of these machines, and what relates to an engine of one style is of no application to one of another class. Instructions for working are always sent with the engines, and they should be closely followed.

CHAPTER VIII.

FIRE FIGHTING.

GENERAL ELEMENTARY INSTRUCTIONS IN EXTINGUISHING FIRES —EACH MAN SHOULD HAVE HIS SPECIAL DUTY—APPLIANCES TO BE USED UNDER VARIOUS CONDITIONS—ATTACHING THE SUCTION HOSE—ATTACKING THE FIRE—NUMBER OF STREAMS TO BE USED—SMALL ENGINES AT A LARGE FIRE—DIFFICULTIES IN CONNEXION WITH WATER SUPPLY—SAFETY OF THE BRIGADE—USE OF THE LARGER APPARATUS TO BE DISCONTINUED AS SOON AS POSSIBLE—DAMAGE BY SMOKE—FARM FIRES—REMOVAL OF HORSES EROM STABLES.

General elementary instructions in extinguishing fires.

A FEW elementary instructions concerning the best manner of dealing with a serious conflagration, for the benefit of those servants who are entrusted with the management of the household brigade, will be in place here.

Each man should have his special duty.

The particular duty which each officer and man is to undertake at a fire should always be clearly understood by himself and his comrades. It is generally arranged that upon receipt of an alarm of fire the superintendent and his principal assistant, whom I will call the deputy superintendent, proceed to the mansion, while the third man, whom I will designate foreman, goes to the engine house and brings the engine and brigade to the spot. On the arrival of the engine the superintendent gives his orders to the foreman as to placing it ; he has previously inspected the place, and understands exactly the certainties and possibilities of the fire spreading. It is a special duty of the assistant superintendent to see that the proper quantity of hose is laid down in the best position. If the engine is a manual, the foreman sees that it is properly manned, in working order, and the fore-

carriage locked; he keeps an account of the time, names, and number of the pumpers, and takes care they are not interfered with in their work. To him also belongs the responsible duty of distributing the refreshers, which, in the case of men at the levers, are, if not necessary, at least inevitable.

The branchman, in whom the whole operations of a brigade at a fire come to a focus, should always be one with a cranium sufficiently furnished, and on his appointment to this special work must be impressed with its exact nature, and the manner he is to go about it; he should also be cautioned against playing upon the bystanders under any circumstances, either at work or practice.

The work of the rank and file is to lay down delivery, attach suction and strainer, and generally to get the engine ready, under direction of the foreman; to clear obstructions, pull down walls or buildings as necessary, or to save property or life where endangered, acting strictly under instructions of the officer in command. To him all enquiries or suggestions must be referred, if it be thought necessary to notice them at all. The brigade are expected to obey all orders promptly and silently, without excitement or shouting.

Appliances to be used under various conditions.

The officer in command decides what appliances it is necessary to bring into use. A handpump or jet from the mains may be sufficient, often in cases where to an inexperienced eye it would hardly seem possible; the engine may be stationed near or even got ready for action, but must not be used till the necessity for it is apparent. The great object to be attained is to put out the fire with as little water, and therefore as little damage, as possible; to attain it every drop of water must be made to do its work—not allowed to squander itself uselessly and to the detriment of property.

Position of the fire engine.

The engine, manual or steamer, will be placed as near the water supply as possible, and sufficient hose laid down to reach the seat of the fire. It serves no useful purpose, as a rule, to get the engine very close to the fire, at least, to make any

sacrifice in order to do this ; especially in the case of manual engines, for the pumpers, if in any real or fancied danger, will work much less steadily than they would at a greater distance. Of course, the less delivery hose there is on, the less friction has to be overcome, and the more easy is the work ; but if, by adding another forty feet, a better water supply can be obtained, clearer or more copious, it should certainly be done.

The first few strokes of the engine should be made slowly ; when the hose has been filled with water and a jet appears at the nozzle faster strokes may be made and full speed attained. In placing the engine care should be taken not to lay down the hose where it may be damaged ; within the building, if it is to be taken upstairs, it should not be laid upon the stairs if it can be avoided, but upon the banisters, where it is much less liable to injury.

Attaching the suction hose.

Great care must also be had in attaching the suction hose to the engine to see that it is quite tight ; the want of a leather washer or a faulty joint from any cause will vitiate the whole performance of the engine. A leak in the delivery hose is comparatively unimportant, but in the suction hose it is fatal. The fact that atmospheric pressure will not raise water more than about thirty feet, and that the vacuum generally obtained in the suction hose will not allow a lift of more than about four-and-twenty feet, is generally understood ; but I mention it here, having in mind a case where some men, trying to get water from a well nearly forty feet deep, wondered why the engine did not work, and sent it up to the makers for examination.

Attacking the fire.

To prevent the fire spreading is the first consideration ; to extinguish it is the second. The best way to enter a burning building is by the door, if it can be done ; otherwise through a window by external means. The branchman must get where he can see the fire, and pour the water directly upon it ; if he cannot enter the building he should stand upon a ladder. By some means he must if possible get himself elevated to the

same level as the highest point the fire has arrived at; so that he may see the water actually strikes the burning mass, and may observe at once when enough has been applied. The water should also be aimed at the highest point of the fire; the water then, having done its work upon the burning material above, will fall below, extinguishing the fire as it does so. Let me again observe that each drop of water should be made to do some useful work; if it does no good it will certainly do harm. At some fires the reckless use of water and hand hatchets has done more damage than could possibly have been done by the fire; indeed I know a public fire brigade which swamped out a three-storey residence and spoiled some hundreds of pounds' worth of furniture, when called to extinguish some burning rubbish in the basement. Goods in floors below the seat of the fire may be protected by waterproof sheeting, rick cloths, &c.

Number of streams to be used.

The question whether one or more jets of water from one engine should be used must be very carefully considered by the officer in command, and with reference to all the circumstances of the case. Unless the fire is spreading rapidly in two or more directions it is advisable to concentrate all the power in the steam cylinder of the steamer, or of the men at the manual levers upon one jet. There is always a serious loss of power when two lines of hose are used. The delivery pipe from the air vessel in a manual engine is usually about the size of the hose, and it is evident that one pipe cannot keep two of equal diameter properly supplied; then, too, there is the greater amount of friction to be overcome in the two lines of hose to be taken into consideration. In small size manual engines, by which I mean those with less than six-inch pumps, two streams are not, under any circumstances, to be recommended.

Small engines at a large fire.

Where a building of large dimensions is on fire and the engines provided are of small capacity, should the fire once gain headway, the brigade will find some hard work cut out for them. If in addition the water supply is limited, the case

may become an exceedingly difficult one to manage. Under such circumstances it is advisable not to take the engine to the water, but to place it as near to the fire as possible without endangering the pumpers, and to select that portion of the fire where the small quantity of water obtainable can do the greatest amount of execution. The water should be taken to the engine in vessels, and poured into the cistern, the suction cap having been adjusted to allow of the engine's taking its supply in this manner. In cases where the fire is below the level of the water supply, as will sometimes happen, the water may perhaps be made to flow from the supply towards the fire, and a hole dug in the ground will act as a dam for the suction pipe. Where the supply is on one side of a hill and the mansion on the other, the difficulty can be overcome by fixing a standpipe with sufficient hose attached to carry the water over the hill; it can then be allowed to run through open hose towards the fire. If again the supply is taken from a pond, and there are two engines present, a good plan, as I have before mentioned, is to work one engine at the water to the top of the hill, whence the water can flow down towards the second engine, placed as near the fire as possible.

Difficulties in connexion with water supply.

The officer in command must make it his business to see that a clear way of retreat is open for the men within the building, and that they are in no danger from falling walls. One man should never be allowed to go alone into a building where fire has made headway. If the smoke is so dense that the men cannot stand erect for fear of suffocation, a stratum of fresh air is always to be found a short distance from the floor, and they can crawl upon their hands and knees without danger from this cause, and with little inconvenience. It is to be remembered, however, that after a fire has broken through a floor, this supply of fresh air is not to be depended upon. If danger be apprehended a life line attached to the belts of the men will enable them to be safely brought out should they become overpowered, and this simple precaution need never be omitted.

Safety of the brigade.

Should it be necessary to enter a house by a window through which flame is bursting, so as to prevent for a time an entrance being made, the water from the branch should be pointed in that direction, nearly perpendicularly, the water striking the ceiling will spread around and make an entrance possible.

Use of the larger apparatus to be discontinued as soon as possible.

As soon as possible the larger apparatus, if it has been brought into use, must be dispensed with; that is to say, as soon as the fire is well under and can be kept sufficiently in check with less water than was at first necessary. Water should never be thrown from buckets, if a hand pump is at hand; not a half the contents of a pail, thrown lightly upon the flames, will go where it is wanted, while every drop from the nozzle of the hand pump hose can be directed to precisely the spot where it is required, and will strike that spot with sufficient force to be of service.

Damage by smoke.

Damage by smoke must be carefully guarded against. Many substances are damaged as much by being subjected to a smoky atmosphere as they would be if they were consumed. It is therefore sometimes necessary to break windows to let out smoke; at others it may be requisite to make an opening at the top of a burning building to allow the hot smoke and foul gases to escape, at the same time allowing a supply of pure air to come in below to replace it. To judge when this may be advantageously done requires a considerable amount of discretion; it is a serious matter to feed the fire by introducing a new supply of oxygen, without which combustion could not be supported, and only when it is apparent that the goods may be saved or the flames better approached, and therefore more rapidly extinguished, should these critical means be adopted. It is to be noted also that the atmosphere must be sufficiently hot to allow an upward draught to carry off the smoke. Occasionally artificial means, such as the ignition of a gas jet, may serve to induce an upward current. This subject will be found more fully discussed on pages 14 to 16 of Captain Shaw's "Fire Protection."

Agricultural fires require a somewhat different treatment to fires of any other kind. If the brigade arrives at the home or an outlying farm before damage has been done to more than one stack, the chief consideration is to confine the fire to the stack already alight. For this purpose, those towards which the wind is setting should be covered carefully in with tarpaulins, if they are to be had; otherwise with blankets or anything of the kind that comes to hand, and a considerable portion of the attention of the branch pipe should be directed to keeping these coverings wet. The burning corn or hay should be pressed together with hayforks; it is a fatal policy to open the stack and allow the burning embers to fly about the rickyard. Some farm labourers may be stationed at each stack to prevent it taking fire. Farm fires.

If the fire is near the stables, and it is desirable to remove the horses, they should be harnessed, if there is time, and their eyes bandaged with a wetted sack, smock frock, or whatever of the sort is handy, and led out as to work; they can then generally be got to a place of safety without much difficulty. Removal of horses from stables.

CHAPTER IX.

SAVING LIFE.

SAVING LIFE FROM FIRE—VALUE OF EARLY INTIMATION OF AN OUTBREAK—ELECTRIC FIRE ALARMS—PRESENCE OF MIND—DIRECTIONS HOW TO ACT ON AN ALARM OF FIRE BEING GIVEN—DOMESTIC FIRE ESCAPES—THE CHUTE ESCAPE—THE ROPE AND PULLEY ESCAPE—ROPE LADDERS—LADDER FIRE ESCAPES ON WHEELS—DIRECTIONS TO PRIVATE BRIGADE FOR SAVING LIFE—SEARCHING THE HOUSE—ENTRY BY THE WINDOWS—RESCUE FROM THE OUTSIDE—BRINGING PERSONS DOWN THE ESCAPE—LIGHT LADDERS.

Saving life from fire.

My work would be performed incompletely if I did not add a word or two concerning the saving of life from fire. It is unfortunate that in regard to this, the most momentous duty which has to be performed at a fire, all that can be said must necessarily be very general in its application.

A country residence standing alone is without the most valuable aid which a building adjoining or even opposite that on fire lends towards the rescue of endangered persons. It is therefore of greater consequence in these than in other buildings where people reside and sleep, although it is of great importance everywhere, to secure the earliest possible intimation that a fire has broken out. For this purpose the most valuable assistance is perhaps found in an automatic electric apparatus. One of the most simple and certain, and simplicity and certainty of action are the great points to be considered, is that known as "Bright's self-acting electric fire detector." This apparatus not only gives warning instantly of undue heat arising in any room, but it also indicates the

Value of early intimation of an outbreak.

Electric fire alarms.

exact place. The detector itself occupies the space of about an inch in each room, it may be fixed out of sight if desired, and it can be set to give warning at any degree of temperature. It makes its communication to an alarm bell or bells, which may be fixed in any part of the building, by the simple action of the electric current. There are many other systems of more or less efficiency upon the same principle.

Presence of mind.

Upon an alarm of fire being given, the safety of the inmates very largely depends, of course, upon their own presence of mind. In nearly every instance it will be given early enough for all the persons in the building to escape by one or other of the stairways if their own proceedings are marked by ordinary prudence. Everybody not of unsound mind must be able to master a few practical directions such as those which follow. Unfortunately an outbreak of fire is liable to cause an outbreak of temporary insanity in the inmates of the house, but if they are invited to learn and consider a few easy rules in times of safety, there is at least a possibility that they may be remembered and acted upon in the time of danger. In many large establishments directions similar to these are brought to the notice of every inmate. Be prompt, and as calm and quiet as possible ; avoid all confusion and unnecessary noise ; ascertain, as soon as you can, where the fire is, and what hold of the place it has obtained, and endeavour to make your way by the stairs to the outside of the house ; if you cannot do this, muster all the inmates in one room at the front of the house, taking care to ascertain that no sick or helpless member of the household has been forgotten. Shut as far as possible, all the doors and windows ; if in bed at the time of the alarm, do not stop to dress, but wrap yourself in a blanket or bedside carpet. Do not hastily take desperate measures for escape ; in the absence of any fire escapes inside the house, and no assistance arriving, do not precipitate yourselves from the windows while there remains the least chance of help being afforded. Even in the last extremity a plain rope is invaluable, or sheets and blankets may be joined together, one end fastened round a bedpost or

Directions how to act on an alarm of fire being given.

other piece of furniture ; this will enable one person to lower all the rest separately, and the last may let himself down with comparatively little risk. A window over the doorway should be selected rather than one over an area.

The above directions pre-suppose the total absence of life-saving apparatus—but this is a condition which can hardly occur in any well regulated house of any size. To obtain the greatest amount of safety, there should be first means in the house for the inmates to aid themselves, and secondly, means to afford them help from the outside.

Domestic fire escapes—The Chute escape.

The most simple and the safest domestic or indoor fire escape I know, is one which is called the "Chute" or "Flume" escape. It consists of a shoot of specially woven canvas material, having an iron frame at the top of a shape which allows its easy adjustment by one person. The frame fits over the window sill, and a cross bar is made of a sufficient length to span across the window opening. The escape is kept in or near the room it is intended for, and when it is required to bring it into use the frame is adjusted to the window and the shoot is thrown to the ground. The first person descending may do so unassisted by outstretching the arms and legs so as to check the speed of descent by friction against the shoot. When the lower end of the shoot is held by some person standing on *terra firma*, one person after another may go down as speedily as they can enter at the top. Male and female, grown persons, invalids and children may descend with equal ease and safety ; and so fast that ten or twelve may place themselves beyond reach of danger in a minute.

The rope and pulley escape.

Another useful domestic escape consists of a suitable length of patent rope working through a pulley, and fitted with a safety belt. It has a strong hook, which can be attached to an eye-bolt to be screwed into the ceiling; the bolt is made additionally secure by means of an iron plate also fixed to the ceiling by strong screws. The belt is placed round the waist of the person to be lowered, the last leaving the room can

without difficulty adjust the belt round his own waist and lower himself down. If this class of domestic escape is adopted, it is advisable to fit a bolt to the ceiling inside the window of every room from which an escape can be effected. The machine itself may be carried from one room to another; it is extremely improbable that the house would be well alight on all sides before the fire was discovered. It would of course be used on that side where there were no flames coming from windows beneath the room where the inmates were assembled.

Rope ladders. Rope ladders are sometimes used, but in my opinion they are dangerous things to trust to; there is a difficulty in making a safe descent without a considerable amount of practice, owing to the swaying of the ladder. An unpractised person stepping out of a window on to one of these ladders would feel it give under his feet, and as a rule would at once relax his hold. I always advise shoot escapes in preference to any others, and I have never heard of a serious accident with one of them. A coil of good strong rope where no better means of escape are at hand has often proved useful.

Fire escapes on wheels. For the assistance of endangered persons from the outside of the building a fire escape on wheels, similar to those used in towns, may be provided and should find a place in the grounds as near to the house as can be arranged conveniently. The cost of these machines is only about £50. I consider the best are those which have two ladders, one working telescopically within the other, as they can be adjusted to any height. The fire escapes used in London have a top ladder, which is turned over when the escape is required for a building which the main ladder does not reach; but these in unpractised hands are more difficult than the telescopic escapes to manipulate and mount, and are not therefore so safe. The escape ought to be kept under cover, and if it is locked up there should be a key in the possession of every trustworthy person connected with the house.

Directions to the private brigade for saving life. Upon an alarm of fire being given, it should be the duty of three of the members of the household brigade to proceed at once to the escape shed, and bring the machine, whether it is likely

to be wanted or not, to the building, placing it in a position of safety against one of the walls; the escape will stand of itself in the open, being provided with a pair of wood legs for the purpose; but it is preferable to rest it against a support of some kind. Every member of the household brigade should make himself perfect in fire escape drill, so that in case of emergency he may be able to act alone or with others.

Searching the house.

Upon the occurrence of a serious fire, supposing the master of the house or the servant who is in command of the household brigade is not absolutely certain that every person who was in the house is in a place of safety, he should at once direct a thorough search of the building to be made. For this purpose the stairs should be used whenever it is possible to do so. It no doubt appears a much more glorious enterprise to rush up a ladder, cut away a window with a hand-axe, and dash into a room from the outside; this must be done where it is unavoidable, but it should be remembered that where the house is well alight, it dooms the place, and if there are any persons at the top or back, it dooms them also to almost certain destruction. The best way to carry out this search, the most hazardous part of the amateur fireman's duty, is to enter by the door, and go by the stairs to the top of the building, first being careful to attach a pocket line to the belt round the waist, and commencing at the top, to explore the rooms and passages as completely as may be, working gradually to the bottom.

Entry by the windows.

If an entry cannot be effected by the door, the frames of a window should not be ruthlessly hacked away with the hand axe; if the fireman breaks a pane near the hasp he can open the window, and by closing it after him considerably reduce the danger to the building and inmates. If he wishes to clear the room of smoke, he may break another small piece of glass below or above the first opening, which will be effective. To breathe in a room full of smoke, the advantage of keeping the head as near the ground as possible is well known; a pocket handkerchief, dipped in water, will make a tolerably good respirator if a better is not available.

Rescue from the outside.

Should reliable information have been obtained that all the persons are in one room, or one set of rooms, the fireman will of course at once proceed there; otherwise he will use his discretion. If he see them at a front window, and knows that exit by means of the stairs is cut off, he will at once pitch the escape, placing the top of the highest ladder he has to use to reach it, just below the window. If he has to use the turn-over, or the lengthening ladder in a narrow place, he must place the escape fore and aft and throw up the ladders in that position, pitching it afterwards with all the help he can get as may be required. The fireman will then ascend the escape, enter the room, and pass down the inmates by the shoot, if the escape has a shoot, otherwise by the ladder or by a line, according to the age and sex of the endangered persons, and other circumstances. If he elects to take them down the ladder upon his back, he must be careful to get upon the floor where they are to place them in position, on no account trying to do this while upon the ladder; he should then, carefully balancing himself, especially at the moment of placing his weight upon the ladder, get upon the machine with the greatest circumspection, and descend with his feet as wide apart upon the rounds as possible.

Bringing persons down the escape.

To place persons in the shoot, the fireman should first lay them face downwards upon the floor, then raising them gradually, he should throw them across his shoulders, and ease them gently, face upwards from his shoulder, into the shoot. Women are usually sent down head foremost, so that their clothing may not catch in the shoot; men either way. The rule is to send down first the women and children, and afterwards the men, but circumstances frequently occur in which this is impossible, and the fireman must do what appears to him at the moment to be best. Unfortunately persons in a situation of danger have very seldom full command over themselves, or any command at all, and if the fireman is not self-contained and resolute serious difficulties may be placed in the way of successful action. He must, therefore, above

all things, act promptly and courageously, and insist upon the most implicit obedience to his commands, because if he hesitate or show signs of pusillanimity, he will throw away his chance of usefulness, or at least greatly diminish it.

Light ladders. It is a good plan to keep also a few light bill posters' ladders in the fore courts, with instructions that they are only to be used as fire escapes.

CHAPTER X.

FINAL.

MANSIONS SAVED BY PRIVATE APPARATUS—CANFORD MANOR; SAVED IN 1879; SAVED IN 1884—HAMPTON COURT PALACE; EFFICIENT VOLUNTEER BRIGADE; HOW THE FIRE ORIGINATED; PROMPT ACTION OF THE BRIGADE; EXCELLENCE OF THE APPARATUS; GALLANT EFFORTS OF THE BRIGADE — DESTRUCTION OF DUNCOMBE PARK; BUCKETS ONLY AVAILABLE; A HANDPUMP WOULD HAVE SAVED THE MANSION—FIRE AT BARLOW HALL; HOW THE LOSS MIGHT HAVE BEEN AVERTED — FIRE AT WALCOTT HALL — A PARALLEL AND A CONTRAST—PARTIAL DEMOLITION OF CLUMBER HOUSE—DESTRUCTION OF BADMINTON AVERTED.

Mansions saved by private apparatus.

I MIGHT fill a much larger book than this with accounts of the saving from destruction by fire of many noble residential houses during the past few years by apparatus which the foresight of the owners had provided against an emergency. Not a half or a tenth of these "stops" reach the public ear; it is only when such appliances are not provided, and the place is greatly damaged or destroyed, that the affair creates a local or a national sensation. I do not, however, think it well to increase the size of this little work by inserting a number of accounts of fires for the purpose of proving the value of efficient fire protection, which is not only self-evident, but is universally admitted even by those who do not avail themselves of it. I have, however, selected from the pages of *The Fireman* a few instances of the kind. The first relates to Canford Manor, the residence of Lord Wimborne, and the account appeared in the impression of that journal for February, 1884, as follows :—

Canford Manor.

"In another column we report the recent outbreak of fire which occurred at Canford Manor, the country seat of Lord Wimborne, and it is assuring to know that at least one of England's baronial halls, with its priceless heirlooms, has been saved from threatened destruction in consequence of the exercise of prudence and foresight.

"The value of possessing fire extinguishing appliances is in some instances doubted, because of the impossibility of employing a thoroughly experienced fireman, but we have now to record the fact that persons who have never before assisted in the extinction of a real conflagration have proved themselves reliable amateur firemen, and have been successful in wresting noble wealth from fiery tongues.

"Many years ago one of Mr. Merryweather's Manual Fire Engines, capable of pumping 100 gallons of water a minute, was procured, and housed in the stable yard at Canford Manor; it was not forgotten and consequently found useless when needed, but periodically worked, and the men upon the estate initiated in its proper use, with the result that on a

Saved in 1879.

November midnight in 1879, its services were demanded by an alarming discovery of a raging fire in the attic bedrooms. The servants were aroused, and quickly pulled the engine to the water supply and put it into action. After a few hours' hard working, with the hose laid up the staircase, the damage was confined to the suite of rooms, without an alarm being conveyed outside the Manor gates.

"Roused by this narrow escape Lord Wimborne lost no time in having water pipes fixed from a reservoir, with hydrants and hose inside the mansion, upon each floor, so as to be available more speedily than the engine, and with need for fewer hands. Extinctors and buckets were also adopted.

Saved in 1884

"At noon on Sunday, the 6th January, 1884, a servant found flames had broken out, from an unascertained cause, in a cupboard under the grand oak staircase, and the violent ringing of the house bell called Lord and Lady Wimborne and

others of the household from Canford Church to the scene of danger. No time was lost by his Lordship in giving directions as to the rescue of such property as was accessible ; and Mr. Towse, the estate clerk of works, resorted to the nearest hydrant on the first floor, the hose of which was speedily put into good use, although the smoke was overpowering, and a second and even third hydrant were made use of to confine the increasing flames, while the house steward removed the valuable plate, and the estate agent superintended the hasty clearance of rooms in danger. The Manor fire engine was run down to the river Stour, and hose taken up over ladders to the roof, while about a dozen willing persons pumped a good jet of water, which broke the glass of the large window of the staircase, and caused the smoke to waft from the corridors, which were previously almost impassable. In this way good work was done, and the fire kept within the staircase walls, notwithstanding the excessive heat, radiated by the flames and the dense smoke, due to the bees-wax polish upon the timber work. The fire steadily passed under the flooring of the great hall, and hatchets and crowbars were necessary to break away the timber, while buckets of water were carried and applied to points of probable danger.

"Three-quarters of an hour after the alarm being given to the Wimborne Fire Brigade, their engine was upon the scene and put into service to aid the Manor staff, but it is certain that had the servants been powerless to deal with the fire for lack of extinguishing appliances readily at hand, and had been forced to await the Wimborne engine, nothing but the bare walls of the entire structure would now be of value.

"Messrs. Merryweather, of Long Acre, London, have made an inspection of the building, and regard the manner in which the fire appliances were utilised as creditable in the highest degree. The amount of damage done is marvellously small considering the position of the staircase, which is entirely consumed from ground to what was once the emblazoned ceiling,

while the great hall and other parts of the house have only sustained slight unavoidable damage by smoke."

Hampton Court Palace.

Hampton Court Palace, as will be remembered, narrowly escaped total destruction on December 14th, 1882. The *Fireman* for the following month says :—

"A thrill of delight may be said, not merely hyperbolically but literally, to have passed through the whole country when it was known on Thursday, the 14th of last month, that the ancient palace of Wolsey had escaped the imminent danger which threatened its destruction. The national loss which would have occurred had the priceless cartoons of Raphael, and the choice works of Vandyke, Kneller, Lawrence, Lely, and Velasquez perished in the flames, cannot possibly be exaggerated, even by the longest string of adjectives which our language will afford. The building itself possesses associations of peculiar interest, dating back not earlier than Tudor times, but connected since that period with the reigning Sovereigns till the days of George II. The old palace was built by Cardinal Wolsey, and by him handed over to his Royal master, probably to avoid a more summary mode of transfer. This was mostly burned in 1690, and the rest of the present palace was built by William III. At Hampton, Henry VIII. spent much of his time; Edward VI. was born there, and resided for some years at the palace with the Duke of Somerset, his guardian. Mary and Elizabeth, James I. and Charles I. passed many years in its pleasant courts, the latter in the days both of prosperity and adversity. 'Our chief of men' loved Hampton, and in his latter years spent there many anxious, weary, and sorrowful days. It was during Cromwell's residence at Hampton Court that his favourite daughter died, and among the more sombre memories of the place is one 'that during the dead of night the grief-stricken Protector bore the body of his child to the river side, and then, followed by a multitude of barges, rowed her down the silent Thames to that grave in the Chapel of Henry VII., where she still reposes.' The associations of the Merry

Monarch with the place are of a more joyful description. William III. resided there frequently, rebuilt part of the palace, planted the chesnut trees in Bushey Park, and gave much time to the gardens ; in his favourite woods he met with the accident which caused his death. Queen Anne and the first two Georges held their courts at Hampton, but from the time of George III. the palace has ceased to be the home of our Sovereigns. It has, of late years, been a particularly favourite resort of London excursionists, to whom it is open both on Sunday and during the week ; its apartments are devoted to the laudable purpose of a home, provided by Her Majesty's bounty, for widows and other representatives of those who have deserved well of the State.

Efficient volunteer brigade.

"The Office of Works and Public Buildings, in whose charge the palace is, have been at great trouble to provide for it every possible protection against fire. A most efficient volunteer fire brigade was established some few years ago, under the command of Mr. Moorman, and its work has frequently been commended in our columns. We understand that weekly fire drills were carried out with unremitting punctuality ; in fact, the night before the fire Mr. Moorman had put his men through their drill. Consequently, when a fire did actually break out, there was no display of ignorance or inefficiency, and the brigade were able to effect one of the most splendid "stops" it has been our pleasure to record. That the damage done was restrained within such narrow limits is owing entirely to the admirable system of hydrants in the building, and the efficient way in which they were used by the Fire Brigade of the palace, as, but for the promptitude with which they were got to work, and the good supply of water at hand, there is little doubt that at any rate the whole of the eastern wing of the building, if not more, would have fallen a sacrifice to the flames. This wing is in four storeys, the ground, second, and third floors being tenanted, and the State apartments being on the first floor. The place where the fire originated was in a bedroom upon the second floor at

the south-east corner of the palace, where a suite of apartments was occupied by a Mrs. Crofton and her daughter. On one side of these the outlook is on to the public gardens, while the windows in the opposite quarter looked into the cloistered quadrangle known as Fountain Court. The bedroom in question was used by a Mrs. Lucas, the cook of Mrs. Crofton, and it would seem that while she was dressing, at about half-past seven in the morning, she overturned a paraffin or benzoline lamp, which at once set the room in a blaze. This she endeavoured to extinguish by throwing water upon it, but finding the flames spreading she ran through the drawing-room and alarmed the inmates, afterwards apparently returning towards her own room, presumably either to again endeavour to put out the fire or else to save some of her property. She was not after this seen alive. When an attempt was made to enter the drawing-room, the suffocating smoke drove every one back, and it was not until some time later that the body was found lying face downward upon the floor, close to the doorway leading to her own room.

How the fire originated.

"Almost at the same moment that Mrs. Lucas gave the alarm a servant in the employ of Mrs. Fitzroy, who, with Lady Torrens, occupied the two suites of rooms upon the floor above, saw flames coming from one of the windows, and she sent for the firemen. Without any delay, Mr. Chart, the Clerk of the Works, and Mr. Moorman, the Superintendent of the Palace Fire Brigade, both of whom live upon the premises, were communicated with, and steps were at once taken to cope with the conflagration, which had now taken a strong hold. Instantly the men of the Brigade, some of whom live in and others out of the Palace, were summoned, and telegrams were despatched to Richmond, Kingston, and other surrounding places where there are Fire Brigades, as well as to the head-quarters of the Metropolitan Brigade in London, the latter only being asked to hold themselves in readiness in case they were wanted. At the same time steam was got up in the powerful stationary engine that supplies the hydrants,

Prompt action of the brigade.

and within a quarter of an hour seven strong jets were playing upon the flames, now burning like a furnace. This machine is capable of pumping 700 gallons per minute; it was a Field quick steam-raising boiler, a pump of the Merryweather type, with large waterways, and cylinder with the simple twist bar arrangement. The excellence of this class of machine was never more conclusively demonstrated than when, in the dark of an early December morning, the safety of the fine old palace depended upon the engine bringing to bear immediately and without mishap upon the flames the whole force of which it is capable. Within fifteen minutes of the alarm being raised as we said, seven jets of water were playing upon the fire, and by the skill and energy of Captain Moorman and his men, who, when called upon suddenly to act, were found, like the big engine, equal to their duty, the palace was saved.

Excellence of the apparatus.

"Not only are all the stairways furnished with hydrants, but so lately as about a year since a large main, with hose ready attached, was laid completely round the roof. From this point, through the ceiling, the firemen were enabled to throw an immense amount of water, as well as from the doorway and also through an inner window looking upon a small square that gave light to the surrounding rooms. A number of stone well staircases lead from below to the private rooms, every suite of which has two exits, and therefore there was no difficulty both for the inmates to escape and for the men to work almost on all sides of the spot where the fire was raging. All the walls are very massive, but the oak wainscoting and panelling favoured the flames, and it was not long before they reached the floor above, at the same time also crossing into the drawing-room in the front and through a small linen-closet to the dining-room at the rear. But by this time the firemen had fairly grappled with the fire, and, assisted by a large number of men of the 4th Hussars, who had turned out promptly on the call, were fighting the foe inch by inch to prevent its extending. Many

of the soldiers, although half-suffocated with the heat and smoke, gallantly worked at removing the pictures and furniture, much of which was of a very valuable character, from the burning rooms into places of safety. Shortly before nine o'clock the brigades from Kingston and Surbiton, followed by those from Richmond, Twickenham, and Moulsey, arrived, and rendered valuable assistance. At this time it was seen that there was sufficient force to cope with the fire, and a message to that effect was sent to Captain Shaw.

Gallant efforts of the brigade.

"When the men of the Fire Brigades found that they were really gaining a mastery over the flames, not only preventing any further spread, but beating it where it was fully alight, they redoubled their efforts, with good effect. Portions of the leaden roof were pulled off, and hose attached to fresh hydrants, the streams of water from all quarters fairly drowning the fire in less than two hours from the time it first broke out. The men had great difficulty in getting close, as the smoke from so much woodwork was dense and pungent. When at last an entrance could be effected, and a thorough examination made, it was found that the bedroom where the fire commenced, and a small corridor adjoining, had been burnt quite out; but, although the floor was reduced to a cinder, the ceiling below, above the Picture Gallery, had not given way. Here was found the remains of a lamp, which was, no doubt, the initial cause of the calamity. The drawing-room, adjoining one way, and the dining-room, on the other, were also damaged by fire, though it had been mainly confined to the corners in which it had started, and along the wainscoting of one wall in each room. This wainscot had acted like a flue to carry the flames upwards to Mrs. Fitzroy's rooms, four of which were considerably injured, though in neither case had it been permitted to extend itself over the entire room. The intense heat in the principal seat of the fire was shown by the zinc water pipes outside the windows having been completely melted, and by many of the windows of the turret lights above the well staircase on to which the room led being broken

from the same cause, though the flames never reached them. Though the injury to property caused by actual burning was so small, that by water and removal was considerable.

"Our hearty congratulations are due to Captain Moorman, and to the palace officials, upon their success in preventing a calamity to the nation, and to art. The fire should enforce a lesson we have long endeavoured to inculcate. A resident Fire Brigade, formed of inmates and servants, should be attached to every Royal Palace and other large public building or residential mansion; should be thoroughly drilled, and provided with the necessary apparatus with no niggardly hand; then with proper attention paid to keeping the appliances ready for instant application, the buildings will be as safe as human care can make them. There are few more inflammable or fire inviting structures in the country than Hampton Court Palace, and what has been done there may, with like care and forethought, be done everywhere."

Destruction of Duncombe Park.

There is another picture upon which it is well to look. I quote again from *The Fireman* of February, 1879:—"The Earl of Feversham's splendid mansion at Duncombe Park was one of the finest works of Sir John Vanbrugh. Built in 1718 by William Wakefield, of Easingwold, it was well known to tourists, the noble owner generously throwing it open to the public. Amongst the rare and valuable works of art contained within its walls were splendid antique statues of Mars, Mercury, Apollo, and Bacchus, together with two specimens of the famous Greek sculptor, Myron, who flourished 440 B.C. —the Dog of Alcibiades and a Discobolus, or Quoit-thrower.

"On Saturday morning, the 11th ult., at half-past five o'clock, a chimney sweeper from Kirby Moorside, who visits the Hall regularly to examine the flues, knocked at the door on his usual errand. Three of the housemaids, who slept in the green-room, were about the same time awakened by the smell of smoke. Jumping out of bed, they found the green-room floor and the ceiling of the grand saloon on fire. They instantly gave an alarm, and the butler and second coachman came to the spot,

Buckets only available.

and *stood in the room throwing water on the fire as fast as twelve servant girls could bring it in buckets.* They were at last, however, driven out by the smoke and flames. The man who looks after the water pumping and the plumber and turncock were sent for, but all the taps were found to be frozen, and it was some time before the snow, which had fallen heavily during the night, could be swept from the ground in order to find the fire-plugs. The Kirby Moorside fire-engine and brigade were sent for, but their working was delayed owing to the water-pipes being frozen, and only a poor supply of water could be pumped up from the Rye. The York steam fire-engine was also sent for, but by the time it arrived the building was gutted. The contents of the grand saloon, including the library, and the historical and family portraits, were entirely destroyed, the interior of the premises being rendered a complete wreck.

"Now, it is very evident that the disaster would not have assumed such severe proportions had it not been for the frost, and the consequently limited supply of water. But there are two considerations that at once suggest themselves, and they are these : That at the first alarm hand-pumps should have been used instead of buckets, and that some competent person should have periodically inspected and tested the fire appliances ; a precaution quite as important as having a sweep over from Kirby Moorside to look after the flues. We do not hesitate to say that had a London Brigade or a 'Tozer' hand-pump been available the catastrophe would have been averted."

A hand-pump would have saved the mansion.

I shall conclude my accounts of fires in mansions by inserting another extract from the same journal (April, 1879) :—

"Only in February last we had to speak of the fire at Duncombe Park, now we have to chronicle disasters almost as severe at Clumber House and Barlow Hall. And both these fires might have been checked at their commencement, and much valuable property preserved, had there been appliances on the spot ready for action.

"Barlow Hall, near Manchester, is one of the residences of Mr. W. Cunliffe Brooks, M.P., and banker. It has some interesting historical and antiquarian associations, which have reference mainly to the older part of the building, erected some three centuries ago. It was here that the fire broke out, and before the flames were extinguished the greater part of this portion of the mansion was destroyed. On Wednesday, the 19th ult., the only occupants were the housekeeper and a number of servants. About four o'clock a servant had occasion to go into the oak-room, and found that the panelling near to the fireplace was on fire. She communicated with the housekeeper, who despatched messengers to summon to the house the workmen on the estate and on neighbouring farms. Two manual fire engines from Manchester, with a staff of men under Assistant-Superintendent Savage, arrived about half-past five o'clock. Water was obtained from the lake in front of the hall. By the time the firemen got to work the fire had extended to several rooms, and it was pretty clear that much, if not all, of the old wing was doomed. The roof was soon on fire, and very quickly a large piece of it fell in. The firemen worked zealously to check the flames and to prevent their extending to the modern part of the house. Between six and seven o'clock there were indications that the fire was being mastered, though at this time the roof of the dining-room, which is in the modern portion of the hall, became ignited. The firemen were, however, able quickly to check this alarming extension of the conflagration, and shortly after seven o'clock the fire was declared to be entirely subdued. Practically, only the shell of the old wing remains; although there are several rooms in it which are damaged only by water. The fire is believed to have been occasioned by the heat of a flue having set fire to a piece of timber in the wall of the oak-room. The walls were of the old-fashioned kind, composed of wood and brick, which made this part of the mansion peculiarly liable to fire.

Fire at Barlow Hall.

"What a world of trouble, anxiety, and ultimate loss would have been saved had even so simple an appliance as a hand-pump been at once available. A 'Tozer' or a 'London

How the loss might have been averted.

Brigade,' vigorously worked for a few minutes, would have soon told a tale, and left but little for Mr. Savage and his engines from Manchester to do on his arrival. And this is no mere conjecture on our part. Only a few days before, between eight and nine o'clock in the morning, Walcott Hall, near Stamford, the residence of Lord Esme Gordon, was discovered to be on fire. Lady Gordon was awakened by smoke issuing from beneath the floor of her bedroom. She aroused his lordship, and he obtained assistance. A board of the flooring was removed, and a large beam of wood under the hearth, which was smouldering, burst into flames and set fire to the floor. There being proper means at hand, the fire was extinguished before much damage was done. The Stamford fire engine was sent for, but its services were not needed.

Fire at Walcott Hall.

A parallel and a contrast.

"Here we have a parallel and a contrast. The cause of fire —a very common one, by the bye, in old country houses— was almost the same in both houses; but the outcome was very different. In the former instance, reliance had to be placed on others at a distance; result: delay, danger, and destruction. In the latter case proper means were at hand, and were promptly applied; result: speedy extinction, and but little damage. The Stamford fire engine, though sent for, *was not needed*. This should speak volumes to owners of property, who should remember that in fires, as in other anxieties, the proverb holds good, 'Heaven helps those who help themselves.'

Partial demolition of Clumber House.

"On the 26th ult., Clumber House, the seat of the Duke of Newcastle, had a very narrow escape of total destruction; as it was, being nearly demolished. The fire brigade from Worksop were summoned at half-past five o'clock, and on arriving found that the whole of the central portion of the mansion was in flames. Efforts were made to prevent the extension of the fire, but at this time that part of the building lying between the west front, facing the lake, right to the south front, was on fire, including the entrance hall, from the basement to the roof. The pile blazed furiously. The fire

then spread to the large dining-hall, where the late Duke lay in state a month ago, and before the brigade could check its career in this part of the house, it had destroyed the door and a portion of the flooring at the junction with the entrance hall. At eight o'clock the fire was at its fiercest, and at ten o'clock forced its way towards the library and into one of the reception rooms. The whole of the centre of the house was gutted, only the bare walls remaining standing. It was found that the fire originated in a bath-room, where plumbers had been at work with a charcoal fire. It was discovered early in the morning by the house-keeper, who heard a crackling noise, and saw the reflection from her window. There was no resource but to send elsewhere for assistance; meanwhile the little fire, which might have been quickly trodden out, increased in intensity with such rapidity as to defy repression. A stitch in time would have done wonders.

Destruction of Badminton averted.

"At Badminton, a few weeks ago, the destruction of the seat of the Duke of Beaufort, so famous for its hospitality, was averted by the use of hand appliances by his Grace and his eldest son. Well might the Duke remark, in writing to Messrs. Merryweather with particulars of the occurrence, 'that but for such firms as theirs, there would be but little protection for life or property.'

"At Hastings, about the same time, Colonel Byng, whose letter we publish elsewhere, prevented a serious fire by means of a London Brigade hand pump, and we might give a long list of instances of the usefulness of this simple and inexpensive apparatus.

"Are we singular, then, in expressing astonishment that month after month we have to narrate the destruction of time-honoured buildings, ancestral seats of the proudest of our old nobility, or receptacles of the accumulated stores of art and literature, older and prouder still?"

INDEX.

MESSRS. MERRYWEATHER & SONS

ATTEND PERIODICALLY at large numbers of MANSIONS, PRIVATE ESTABLISHMENTS, BANKS, WAREHOUSES, HOSPITALS, INFIRMARIES, WORK-HOUSES, &c., for the purpose of INSPECTING the FIRE EXTINGUISHING APPARATUS, and DRILLING EMPLOYES in its use. An inspection of the Premises is also made at the same time. This system tends to prevent fires occurring, as well as to provide for their prompt extinction should they break out. The cost of the periodical attendance is frequently more than covered by the reduction obtained in insurance premiums. Mr. Austin, Surveyor to Canterbury Cathedral, writes :—

I much approve of the system of periodical inspection by one of your staff, and I commend it unhesitatingly to those who have fire apparatus of any kind, and who are too apt to leave their appliances to the perfunctory care of indifferent sub-ordinates, or perhaps, oftener still, leave them without any over-hauling whatever. The regular attendance of your representative, who is influenced by no considerations but those of doing his duty, acts as a moral check against the possible carelessness of men, and contributes to the maintenance of the machine in a condition of constant preparedness for action.